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Freshwater Algae from Rangtang Himal, Nepal Himalaya*

by

Minoru HIRANO

Up to the present I have submitted two papers on freshwater algae from the Himalayan Mountain region, in 1955 and in 1963 respectively, from different areas; however, the majority of algae was collected from rather lowland areas, and a few were from high alpine areas. I have counted 4 taxa of algae from the alpine pond below Rarkya Pass, 4850 metres above the sea; two of the taxa belong to blue-green algae, and the other two are desmid. I have also published a paper on algae based on the collections from Bhutan Himalaya. There are 47 taxa of freshwater algae found in the alpine lake of Pame Tso, about 4500 metres above the sea. These algae consist of four blue-green algae, 26 taxa of diatom, 15 of desmid, and two other algae.

Recently Dr. FÖRSTER reported many desmids from Khumb Himal but the other groups of algae are not published as yet. There have been some papers on algae from the surrounding area of the Himalaya in the past: Boye PETERSEN wrote a paper in 1926 on the collection of OLUFSEN's Second Danish Pamir Expedition; H. SKUJA's paper in 1932, from South-West China, was based on the collection of HANDEL MAZETTI's expedition; the writer gave two papers, in 1964 and in 1966, from Karakoram and the Southwestern part of Pamir, based on the collection at Kyoto University.

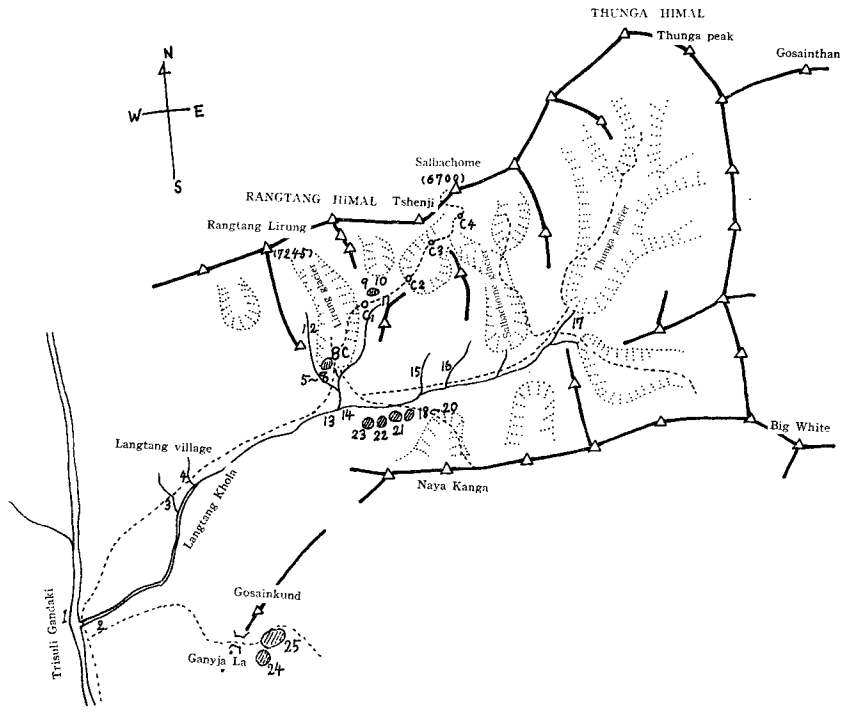
During the mountaineering trip by the Iida Mountain Club of Nagano Prefecture to the Rangtang Himal in 1959, Mr. Setsuo HOJO, a member of the Climbing Expedition collected freshwater algae in the alpine lakes and streams of the alpine zone which faced the Rangtang Valley, and gave me his collections to study. I am grateful to him to have the rare opportunity of studying these valuable specimens.

The collections were made chiefly in the glacier lakes and streams of the alpine zone, near a base camp settled about 3800 metres above the sea. They are listed below.

* This study is partly supported by the grant of the Ministry of Education

Sample-number	date	water-temperature	altitude (m.)	collecting place and notes
No. 1	4 Oct.	11.5°C	2000	Trisuli River near Sharvegan village. Net sample but no organism
2	4 Oct.	11.0°C	2000	Rangtang River near Sharvegan village. River joins other branches in this place
3	6 Oct.	11.0°C	2800	Branch stream of Rangtang River situated at the upper part of Sharvegan village. Collected from river-bed.
4	6 Oct.	11.0°C	2800	A branch stream of Rangtang River but not same as above. Attached to stream bed.
5	8 Oct.	9.0°C	3800	A pool near base camp, situated at the lower edge of Lirum glacier. Collected from among green algae.
6	8 Oct.	9.0°C	3800	Same pool. Collected by net.
7	8 Oct.	9.0°C	3800	Same pool. From mud-bottom.
8	8 Oct.	0°C	3800	Attached substance and detritus in the small stream from glacier near base camp.
9	28 Oct.	3.0°C	4300	A pool near lower edge of Tchenie glacier.
10	28 Oct.	3.0°C	4300	The pool same as above. From mud but no organism.
11	28 Oct.	6.0°C	4200	Mud bottom and attached substance in stream on the slope of Mt. Salbachiome. The slope was covered with grass.
12	30 Oct.	—	3900	In the stream beside the side moraine of Lirum glacier.
13	15 Nov.	—	3700	Rangtang River near base camp. From attached algae.
14	15 Nov.	2.0°C	3700	Same as above place. Net sample.
15	10 Nov.	—	3800	A branch stream of upper Rangtang River. Among algae.
16	10 Nov.	—	3800	Same as above. Other small branched stream.
17	7 Nov.	—	4000	Upper part of Rangtang Valley. By mud.
18	1 Nov.	6.0°C	3700	Glacier lake no.1 in the Rangtang Valley. By net.
19	1 Nov.	6.0°C	3700	Same lake. From algae.
20	1 Nov.	6.0°C	3700	Same lake. From water plant and deposit.
21	1 Nov.	7.0°C	3700	Glacier lake no. 2. By net.
22	1 Nov.	5.0°C	3700	Glacier lake no. 3. From algae.
23	14 Nov.	—	3700	Glacier lake no. 4. From water plant.
24	23 Nov.	1.5°C	4500	Glacier lake on the Gozainkund. By net.
25	23 Nov.	1.5°C	4500	Same. From deposit.

Reference: Snow line in autumn in Central Himalaya is 4800 metres above the sea.



The materials obtained from the alpine lakes come from two different places: one is from the glacier lake of Gosainkund, lying 4500 metres above the sea, and the other is from the four alpine lakes lying in the Rangtang Valley of same level of 3800 metres above the sea. The water temperatures of glacier lake on the Gosainkund is 1.5°C on the 23rd of November, while the water temperature of the four alpine lakes of Rangtang Valley are 5–7°C in the same level of altitude, on the first of November. The collections of the first number lake in the Rangtang Valley were obtained by three different methods: plankton, submerged mass of algae, and mud bottom deposit. The plankton sample is composed of some species of zooplankton, but does not always contain phytoplankton in the true sense of plankton; however, there was some species of algae which were probably brought by the disturbance of surrounding water in the collection. The three kinds of collections obtained from the same lake suggest that that method is more effective. The following is a list of the algae found in each sample:

No. 18: *Pediastrum integrum, Oocystis elliptica* f. *minor, Gonatozygon monotaenium, Cosmarium norimbergense* f. *depressa, Hyalotheca dissiliens, Spirogyra* sp., *Zygnema* sp., *Sphaerozosma granulatus, Pinnularia crucifera* var. *elongata, Cymbella lanceolata, Surirella linearis,* and *Cyclotella comta.*

No. 19: *Aphanocapsa elachista* var. *planctonica, Phormidium valderiae, Stigonema*

mamillatum, Microcoleus subtorulosus, Oocystis solitaria, Oedogonium rufescens var. *exiguum, Cosmarium botrytis, C. pseudoprotuberans* var. *angustius, C. reniforme, C. quadratum, C. minimum* var. *rotundatum, Staurastrum punctulatum, Hyalotheca dissiliens, Tabellaria flocculosa, Cyclotella comta, Pinnularia crucifera* var. *elongata, P. major* var. *linearis, Cymbella lanceolata,* and *Surirella linearis.*

No. 20: *Oscillatoria animalis, O. pseudominima, Schizothrix lacustris, Lyngbya epiphytica, Stigonema ocellatum, Scytonema mirabile, Nostoc* sp., *Scenedesmus ecornis, Chaetosphaeridium globosum, Oocystis elliptica* f. *minor, Gloeocystis gigas, Cosmarium impressulum, C. pseudoprotuberans* var. *angustius, C. reniforme, C. quadratum, C. undulatum* var. *crenulatum, C. regnellii* f. *minima, C. obtusatum, C. tinctum, C.polonicum, C. globosum, C. subcrenatum, C. gostyniense, C. connatum, C. margaritiferum, Euastrum cuneatum, E. oblongum, E. bidentatum, E. binale* var. *gutwinskii, Staurastrum subcruciatum, St. avicula* var. *subarcuatum, St. hirsutum, Closterium gracile, Gonatozygon monotaenium, Cyclotella comta, Eunotia arcus, E. valida, Stauroneis phoenicenteron* var. *lanceolata, Navicula lanceolata, Pinnularia viridis* var. *fallax, P. major, Frustulia vulgaris, Anomoeoneis serians* var. *brachysira, Cymbella lanceolata, C. gracilis, C. ventricosa* var. *minuta.*

According to the observation of Mr. Setsuo Hojo, the snow line in autumn in Central Himalaya is said to be drawn by the altitude of about 4800 metres sea level so that the circumstance of the four alpine lakes in the Rangtang Valley, lying at 3800 metres sea level, is not severe for the growth of algae; and also, the water temperature of 5° or 6°C in autumn shows that the habitat is not as bad as those of the glacier lake of Gosainkund at an altitude of 4500 metres sea level exhibiting 1.5°C water temperature. The present record suggests that the algae-flora of pool, lake, and wet soil in the alpine grassy area, supplied by the water below the glacier, will be richer than can be imagined.

The first lake is about 100 metres round, about 2 metres in depth, its shore is covered in part with *Betula* shrub, but the majority is gravel. Water of the first lake is clear and flows into the second lake probably underground. The second lake is deeper than the first one, about 4 metres in depth and about 150 metres round. The lake is about 10 metres distant from the first one, its shore is gravel. The collections of the second lake were made by plankton net. The species found there are as follows: *Oscillatoria telebriformis, Chaetosphaeridium globosum.*

Water of the second lake flows into the third by a definite stream. The outline of the third lake is not distinct, owing to the marshy condition at the side of the fourth lake. The collections of the third lake consist of epiphyte on algae. The species are the following: *Oscillatoria animalis, O. tenuis* var. *nigra, Pediastrum boryanum, Closterium acerosum, Cosmarium botrytis* var. *rangtangense, C. subcostatum,*

C. subcrenatum, Staurastrum spongiosum, St. dilatatum, Hyalotheca dissiliens, Tabellaria flocculosa, Diatoma hiemale var. *mesodon, Fragilaria capucina, Eunotia tschirchiana, Navicula pupula* var. *bacillarioides, Stauroneis phoenicenteron* var. *lanceolata, Pinnularia major* var. *convergens, P. stauroptera* var. *subparallela, Gomphonema gracile* var. *naviculoides, Cymbella lanceolata.*

The shore of the fourth lake is gravel and the lake is distinguished from the third one by a rocky area, and is probably supplied underground. *Potamogeton natans* and *Utricularia* species are growing in this lake, and I found many species of desmids and diatoms in the collection among the water plants. The list of the algae are as follows: *Chroococcus turgidus* var. *maximus, Aphanothece microscopica, Scytonema mirabile, Anabaena papillosa, Stigonema ocellatum, S. mamillatum, Nostoc* sp., *Botryococcus braunii, Oocystis solitaria, O. elliptica* f. *minor, Schizochlamys delicatula, Chaetosphaeridium globosum, Oedogonium suecicum, Gonatozygon monotaenium, Characium gracilipes, Closterium dianae, Cosmarium logiense, C. quadratum, C. regulare, C. pseudoprotuberans* var. *angustius, C. subtumidum, C, diplosporum* f. *minor, C. regnellii* f. *minima, Euastrum bidentatum, E. oblongum, E. cuneatum, Staurastrum spongiosum, St. punctulatum, Tabellaria flocculosa, Melosira granulata, Frustulia rhomboides* var. *saxonica, Eunotia praerupta* var. *bidens, E. papillio, Neidium iridis, Pinnularia borealis, P. major* var. *convergens, P. stauroptera* var. *subparallela, Cymbella lanceolata, C. gracilis, Gomphonema gracile* var. *naviculoides, Surirella linearis.*

Judging from the collections of these four lakes which have the same level of habitual condition the collecting method by plankton net only makes it difficult to understand the alpine flora of algae. These alpine lakes are small in area, and about 100 or 150 metres round. There is no true plankton form differentiated to the floating life except the cosmopolitan species, such as *Dictyosphaerium pulchellum* and *Characium gracilipes*, because these two planktonic species are found in the centre or also in the littoral zone of the lake and pond. The algae flora of the third lake increase the number of species if the collections are made by scraping the decayed stem and leaf of water plant, or by gathering the bottom deposit; the flora of the third lake is not essentially different from those of the fourth lake. These four alpine lakes are not so severe as a growing habitat as those of a temperate region because the existence of the *Betula* shrub and situation of the mountain, located at a lower latitude than those of the temperate districts, provides a mild condition for the growing of algae. In fact the majority of species found in these lakes are already known from the temperate districts of Europe and Japan.

Besides these lakes there is a shallow lake near the lower end of Lirung glacier; its altitude is about 3800 metres above sea level and lies on the opposite side of Rangtang river against the above alpine lakes. This lake is about 100 metres round

and one metre in depth, surrounded by a grassy area. There is no outflow or inflow of a stream to or from the lake. The collections consist of three vials: by net, scraping the attached substance, and by gathering mud-bottom deposit. The species obtained in the collections are listed separately as follows.

No. 5: *Cosmarium garrolense, C. undulatum* var. *wollei, C. regnellii* f. *minima, C. wittrockii, C. asphaerosporum* var. *strigosum, Staurastrum punctulatum,* and var. *kjellmani, Diatoma hiemale, Tabellaria flocculosa, Cymbella cymbiformis* var. *multipunctata, C. cistula, Gomphonema lanceolatum.*

No. 6: *Phormidium autumnale, Aphanothece grevillei, Pandorina morum, Closterium leibleinii, Cl. cornu, Cosmarium praemorsum, C. subcostatum* f. *minor, Staurastrum punctulatum* and var. *kjellmani, St. dickiei* var. *circulare, Cymbella ventricosa, C. aspera* var. *minor* and *Gomphonema lanceolatum.*

No. 7: *Nostoc* sp., *Pandorina morum, Scenedesmus ecornis, Closterium calosporum* var. *brasiliense, Cosmarium praemorsum, C. regnellii* f. *minima, C. formosulum, C. subcostatum* f. *minor, C. impressulum* var. *johorense, C. subspeciosum, C. meneghinii* f. *himalaica, C. abscissum* var. *subetchachanense, C. octagonum, Staurastrum punctulatum* and var. *kjellmani, St. avicula, Closterium pseudolunula, Cl. leibleinii, Gonatozygon monotaenium, Diatoma hiemale, Tabellaria flocculosa, Cymbella aspera, C. cymbiformis* var. *multipunctata, C. ventricosa, Gomphonema lanceolatum.*

The species found in the plankton sample are all epiphytic or bottom living.

Among the collections from mountain streams, the highest place is a small stream from the slope of the Mt. Salbachome; its altitude is 4200 metres above the sea. Water temperature is 6°C. The collection is a bottom deposit in the stream and the content is chiefly diatoms and was mixed with some species of blue-green algae. The species are: *Oscillatoria angustissima, Phormidium autumnale, Diatoma hiemale* var. *mesodon, D. elongata* var. *tenuis, D. vulgaris* var. *linearis, Neidium iridis, Cocconeis placentula* var. *lineata, Anomoeoneis serians* var. *brachysira, Navicula cryptocephala, Pinnularia macilenta, P. microstauron, P. biceps, P. hustedtii* var. *rangtangense, Cymbella ehrenbergii, C. ventricosa* and var. *minus, Gomphonema parvulum, Hantzschia amphioxys* var. *amphilepta, Nitzschia goetzeana* var. *gracilior.*

Four collections were brought separately from the different places in the neighbourhood at the lower end of the glacier. The collection of no. 12 is from the small stream on the outside of the side moraine of Lirung glacier; its level is 3900 metres in height. The contents of no. 12 are some diatoms and blue-green algae. *Oscillatoria amoena, O. brevis, O. splendida, Phormidium autumnale, Lyngbya sordida, Diatoma hiemale,* and *Ceratoneis arcus* var. *recta.*

The collection of no. 8 is an outflow from the Lirung glacier; its water temperature is about 0°C, and *Hydrurus foetidus* and some algae, as follow, were growing there.

Oscillatoria agardhi, Closterium leibleinii, Cosmarium pericymatium var. *notabiliforme, Oedogonium sociale, Diatoma hiemale* var. *mesodon, Fragilaria capucina* var. *lanceolata, Cymbella aequalis* var. *subaequalis, C. naviculiformis,* and *C. cistula.*

The collections of no. 15 and no. 16 were brought from the branch stream at the upper part of the Rangtang River, separately. These places are situated at 3800 metres above sea level, near the base camp. Nos. 15 and 16 contain the following species separately.

No. 15: *Phormidium favosum, Cosmarium subspeciosum, C. pachydermum.* var *minus, Staurastrum punctulatum, Diatoma hiemale* var. *mesodon, Tabellaria flocculosa, Melosira granulata, Synedra rumpens, Eunotia lunaris, Eunotia pectinalis* var. *minor, Pinnularia macilenta, Cymbella naviculiformis, C. lanceolata.*

No. 16: *Phormidium autumnale, Zygnema* sp., *Achnanthes lanceolata, Diatoma hiemale* var. *mesodon, Eunotia lunaris, E. pectinalis* and var.*minor, Anomoeoneis exilis* var. *lanceolata, Tabellaria flocculosa, Pinnularia crucifera* var. *elongata, C. major* var. *linearis, Cymbella lanceolata, Hantzschia amphioxys* var. *amphilepta.*

Two other vials were brought from two branch streams of the lower part of the Rangtang River separately by scraping of the stream bed. These are 2800 metres in height. One vial contains *Prasiola formosana* and the other (no. 3) contains many diatoms and some species of blue-green algae as follows: *Phormidium boryanum, Nostoc* sp., *Lyngbya nigra, Cosmarium retusum* var. *angustatum, C. westii* var. *attenuatum, Tabellaria flocculosa, Synedra ulna* and var. *ramesi, Diatoma hiemale* var. *mesodon, Fragilaria capucina, Achnanthes exigua* var. *constricta, A. kryophila, Eunotia arcus, E. nepalense, E. pectinalis* var. *undulata, Anomoeoneis serians* var. *brachysira, Navicula cryptocephala, Navicula siofokensis, Pinnularia borealis, Diploneis elliptica, Cymbella aspera, C. ventricosa* var. *minuta, C. gracilis, Gomphonema gracile* var. *naviculoides, G. abbreviatum, Epithemia arcus* var. *amphicephala, Hantzschia amphioxys* var. *pusilla.*

CYANOPHYTA

Chroococcaceae

Aphanocapsa elachista W. & G. S. West var. **planctonica** G. M. Smith in Wisc. Bull. **57**, p. 42, pl. 3, f. 3, 1920; Geitler, Süssw. -fl. **12**, p. 65, 1925; Huber-Pstalozzi, Binnengew. **16**: 1, p. 138, f. 9, 1938.

Colonies subspherical; cells disposed somewhat in pair, 3–3.2μ in diameter.

Hab. No. 19. Distr. Sumatra and N. America.

Aphanocapsa grevillei (Hass.) Rabenh. in Geitler, Süssw. -fl **12**, p. 65, f. 57, 1925;

FRÉMY, Arch. Bot. **3**, MÉM. **2**, p. 25, f. 25, 1930; HUBER-PESTALOZZI, Binnengew. **16**: 1, p. 139, f. 14, 1938; HIRANO, Faun. Flor. Nepal Himalaya p. 8, pl. 1, f. 5, 1955.

Colonies spherical; cells 4.4–4.6μ in diameter.

Hab. No. 6. Distr. Nepal, Ceylon, China, Japan, Manchuria, Europe, U.S.A., and Africa.

Aphanothece microscopica NÄG. in GEITLER, Süssw. -fl. **12**, p. 73, f. 67, 1925; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 29, f. 30, 1930; HUBER-PESTALOZZI, Binnengew. **16**: 1, p. 143, f. 21, 1938.

Cells fairly densely disposed, slightly longer than broad, 6.2–6.4μ long and 4.4–4.6μ broad; colonies spherical, about 350μ in diameter.

Hab. No. 23. Distr. India, Burma, Szechwan. Probably cosmopolitan.

Aphanothece pallida (KÜTZ.) RABENH. in FRÉMY, Arch. Bot. **3**, MÉM. 2, p. 29, f. 31, 1930; GEITLER, Krypt. Fl. **14**, p. 171, f. 78, 1932; HUBER-PESTALOZZI, Binnengew. **16**: 1, p. 143, f. 22, 1938.

Colonies amorphous; cells loosely disposed in mucous envelope, slightly longer than broad, 6.2μ broad and 8.8μ long.

Hab. No. 20. Distr. India, Pakistan, Java, Europe, and N. America.

Chroococcus turgidus (KÜTZ.) NÄG. var. **maximus** NYGAARD in HUBER-PESTALOZZI, Binnengew. **16**: 1, p. 147, f. 26, 1938; SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**: 5, p. 20, pl. 1, f. 10, 1949; DESIKACHARY, Cyanoph. p. 102, pl. 24, f. 2, pl. 26, f. 8, 1959.

Colonies composed of two cells, about 62μ broad and 68μ long. Mucous envelope stratified in inner portion but amorphous in outer one; cells 48μ in diameter.

Hab. No. 23. Distr. Burma.

Synechococcus aeruginosus NÄG. in GEITLER, Krypt. Fl. **14**, p. 274, f. 133d, e, 1932; DESIKACHARY, Cyanoph. p. 143, pl. 25, f. 6, 12, 1959.

Cell 35μ long and 25μ broad.

Hab. No. 20. Distr. Burma, Japan and Europe.

Chamaesiphonaceae

Chamaesiphon incrustans GRUN. forma **asiatica** WILLE in S. Tibet, **6**, p. 166, 1922; GEITLER, Süssw. -fl. **12**, p. 154, 1925.

Trichomes 4.5–4.8μ long and 3.5μ broad.

Hab. No. 25. Distr. Pamir.

Oscillatoriaceae

Oscillatoria agardhii GOMONT in Monogr. Oscill. p. 205, 1892; GEITLER, Süssw. -fl. **12**, p. 369, f. 455, 456, 1925; FRÉMY, Mém. Soc. Nat. Sci. Nat. -Math. Cherb. **41**, p. 123, pl. 31,

f. 4, 1934; HUBER-PESTALOZZI, Binnengew. **16**: 1, p. 240, f. 190, 1938.

Trichomes straight, but slightly curved near the apex, which is slightly attenuated and rounded at the extremity, not constricted at the cross wall; cells almost as long as broad or a little longer, with a series of granules along the cross wall, 4.4μ in diameter.

Hab. No. 8. Distr. India, Ceylon, Yunnan, Kwantung, Burma and Europe.

The present specimens resemble *O. formosa* but differ from it by not having a constricted cross wall of trichome.

Oscillatoria amoena (KÜTZ.) GOMONT in Monogr. Oscill. p. 255, pl. 7, f. 9, 1892; GEITLER, Süssw. -fl. **12**, p. 370, f. 450, 1925; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 220, f. 190, 1930; DESIKACHARY, Cyanoph. p. 230, pl. 40, f. 12, 1959.

Trichomes slightly flexuous, slightly constricted at the cross wall, blue-green in colour, 3μ in diameter; cells about as long as broad or a little longer.

Hab. No. 12. Distr. Burma, Yunnan, Szechwan, Kwantung, Java, Europe, N. America and Africa.

Oscillatoria angustissima W. & G. S. WEST in GEITLER, Süssw. -fl. **12**, p. 364, 1925; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 217, 1930; DESIKACHARY, Cyanoph. p. 227, 1959.

Trichomes straight, narrow, 1.3μ in diameter and blue-green in colour.

Hab. No. 11. Distr. Pamir, Yunnan, Burma, Africa and N. America.

Oscillatoria animalis AG. in GOMONT, Monogr. Oscill. p. 247, pl. 7, f. 13, 1893; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 223, f. 193, 1930; GEITLER, Krypt. Fl. **14**, p. 978, f. 603a, 1932; DESIKACHARY, Cyanoph. p. 239, pl. 40, f. 14, 1959.

Trichomes straight, but slightly curved on one direction near the apex; apices slightly attenuated and rounded at the extremity; not constricted at the cross wall, 3.8–4μ in diameter; cells slightly shorter than the diameter, blue-green in colour, and content without granule.

Hab. Nos. 20, 22. Distr. India, Ceylon, Europe, N. America, Africa and Australia.

Oscillatoria brevis KÜTZ. in GOMONT, Monogr. Oscill. II, p. 249, pl. 7, f. 14, 15, 1893; GEITLER, Süssw. -fl. **12**, p. 371, f. 457, 1925; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 223, f. 195, 1930; Mém. Soc. Nat. Sci. Math. -Nat. Cherb. **41**, p. 125, 1934; HUBER-PESTALOZZI, Binnengew. **16**: 1, p. 241, f. 193, 1938.

Trichomes straight, gradually attenuated toward the apex, apex rounded, not constricted at the cross wall, 5.7μ in diameter; cells short, about 1/3 times as long as broad. Pl. 1, fig. 19.

Hab. Nos. 12, 13. Distr. Cosmopolitan.

Oscillatoria pseudominima SKUJA in Nov. Act. Reg. Soc. Ups. ser. IV, **16**: 3, p. 60, pl. 6, f. 13–15, 1956.

Trichomes narrow and slender, straight, about 1.4μ in diameter, not constricted at the cross wall, not attenuated to the apex; cells elongate, about 4–6, up to 10 times longer than broad, with a pair of granule on each side of the cross wall. Pl. 1, fig. 14.

Hab. No. 20. Distr. Burma.

The specimens do not exactly coincide with the typical description, but have a longer cell than the form reported by SKUJA.

Oscillatoria splendida GREV. in GEITLER, Süssw. -fl. **12**, p. 370, f. 449, 1925; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 220, f. 191, 1930; Mém. Soc. Nat. Sci. Nat. -Math. Cherb. **41**, p. 123, pl. 31, f. 5, 1934; HUBER-PESTALOZZI, Binnengew. **16**: 1, p. 237, f. 187, 1938.

Trichomes slightly flexuous, not constricted at the cross wall; granulated at the cross wall, 3.5μ in diameter; cells 1.5 times longer than broad. Pl. 1, fig. 18.

Hab. No. 12. Distr. India, Burma, Yunnan, and probably cosmopolitan.

Oscillatoria telebriformis (AG.) GOMONT in GEITLER, Süssw. -fl. **12**, p. 367, f. 449, 1925; Krypt. Fl. **14**, p. 954, f. 607d, 1932; HIRANO, Faun. Flor. Nepal Himalaya p. 10, pl. 1, f. 15, 1955; DESIKACHARY, Cyanoph. p. 217, pl. 38, f. 16, 1959.

Trichomes slightly attenuated toward the apex, slightly spirally curved near the apex, not constricted at the cross wall, 4.4μ in diameter; cells about as long as broad or a little shorter, with granulate content.

Hab. Nos. 21, 25. Distr. Nepal, India, Yunnan, Szechwan, Java, Sumatra, and Europe.

Oscillatoria tenuis AG. var. **nigra** SCHKORB. in GEITLER, Süssw. -fl. **12**, p. 363, 1925.

Trichomes straight, not attenuated at the apex, apex rounded at the extremity, not constricted at the cross wall, with a series of granule along the cross wall, 6.2μ in diameter; cells shorter than the diameter. Pl. 1, fig. 17.

Hab. No. 22. Distr. Europe.

Phormidium autumnale (AG.) GOMONT in GEITLER, Süssw. -fl. **12**, p. 388, f. 494, 1925; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 164, f. 143, 1930; HIRANO, Faun. Flor. Nepal Himalaya p. 11, pl. 1, f. 19, 1955.

Trichomes straight but slightly curved in one direction near the apex and attenuated; not constricted at the cross wall, apex capitate; cells about as long as broad or a little shorter, with or without a series of granules along the cross wall, cells 3.5–4.4μ broad. Mucous sheath yellowish.

Hab. Nos. 6, 11, 12, 16, 17. Distr. Cosmopolitan.

Phormidium boryanum KÜTZ. in GEITLER, Süssw. -fl. **12**, p. 382, 1925.

Trichomes straight, not attenuated toward the apex, blue-green in colour, 3.5μ in diameter; not constricted at the cross wall; cells about as long as broad, without a series of granule along the cross wall.

Hab. No. 3. Distr. Cosmopolitan.

Phormidium favosum (BORY) GOMONT in Monogr. Oscill. p. 180, pl. 5, f. 14, 15, 1892; GEITLER, Süssw. -fl. **12**, p. 387, f. 492, 1925; DESIKACHARY, Cyanoph. p. 275, pl. 44, f. 20, 21, 1959.

Trichomes attenuated and curved near the apex, apical cell capitated, not constricted at the cross wall, about 4.4μ in diameter; cells slightly shorter than long or about as long as broad.

Hab. No. 15. Distr. India, Burma, Szechwan, and probably cosmopolitan.

Phormidium valderiae (DELP.) SCHMIDLE in GEITLER, Süssw. -fl. **12**, p. 381, f. 481, 1925; FRÉMY, Mém. Soc. Nat. Sci. Nat. -Math. Cherb. **41**, p. 87, pl. 23, f. 2, 1934.

Trichomes flexuous, not constricted at the cross wall, not attenuated at the apex, 2.6–2.8μ in diameter; cells longer than broad, with a granule on both side of the cross wall. Pl. 1, fig. 20.

Hab. No. 19. Distr. Afghanistan and Europe.

Lyngbya aerugineo-coerulea (KÜTZ.) GOMONT in Monogr. Oscill. p. 166, pl. 4, f. 1–3, 1893; GEITLER, Süssw. -fl. **12**, p. 408, f. 524, 1925; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 190, f. 157, 1930.

Trichomes straight, not constricted at the cross wall, with a distinct series of granules along the cross wall; cells short, about 0.5 times longer than broad, 4.5–5μ in diameter.

Hab. No. 14. Distr. Cosmopolitan.

Lyngbya epiphytica HIERON. in GEITLER, Süssw. -fl. **12**, p. 397, 1925; HUBER-PESTALOZZI, Binnengew. **16**: 1, p. 249, 1938; DESIKACHARY, Cyanoph. p. 284, pl. 53, f. 7, 1959.

Trichomes spirally flexuous, attached to the Scytonema-trichome, about 1μ in diameter, not attenuated toward the apex which is rounded; cells longer than broad. Pl. 1, fig. 15.

Hab. No. 20. Distr. Burma, Yunnan, Szechwan. Cosmopolitan.

Lyngbya nigra AG. in GOMONT, Monogr. Oscill. p. 145, pl. 3, f. 16, 1892; GEITLER, Süssw. -fl. **12**, p. 405, f. 518, 1925; DESIKACHARY, Cyanoph. p. 317, 1959.

Trichomes somewhat curved, not constricted at the cross wall, not attenuated toward the apex, 5μ in diameter; cells short, 1/3 times longer than broad, cell content dark green in colour and granulated.

Hab. No. 3. Distr. India, Ceylon, and Europe.

Lyngbya sordida (ZANARD) GOMONT in FRÉMY, Mém. Soc. Nat. Sci. Nat. -Math. Cherb. **41**, p. 103, pl. 26, f. 5, 1934; DESIKACHARY, Cyanoph. p. 285, pl. 52, f. 1, 1959.

Trichomes straight, constricted at the cross wall, 13μ in diameter; mucous sheath fairly thick and hyaline; cells short, about 1/3 times longer than broad, cell content granulate.

Hab. No. 12. Distr. Ceylon and Europe.

Microcoleus subtorulosus (BRÉB.) GOMONT in Monogr. Oscill. p. 369, pl. 14, f. 14, 15, 1892; GEITLER, Krypt. Fl. **14**, p. 1143, f. 751, 1932; DESIKACHARY, Cyanoph. p. 345, pl. 56, f. 8, 9, 1959.

Trichomes constricted at the cross wall, 6.2μ in diameter; cells with granulate content, about as long as broad or a little longer.

Hab. No. 19. Distr. Szechwan and Europe.

Schizothrix lacustris A. Br. in FRÉMY, Arch. Bot. **3**, Mém. 2, p. 96, f. 92, 1930; DESIKACHARY, Cyanoph. p. 325, pl. 56, f. 6, 10, 1959.

Filaments sometimes branched, contain two trichomes; sheath gelatinous and stratified; trichomes parallel or somewhat crowded, not constricted at the cross wall, 1.3μ in diameter, with or without a distinct granule on each side of the cross wall; cells 1.5–2.5 times as long as broad.

Hab. No. 20. Distr. India, Szechwan, and probably cosmopolitan.

Nostocaceae

Nostoc sp.

Colonies spherical or elliptical, sometimes diffluent into a mucous envelope which is colourless; trichomes strongly flexuous, 4.4μ in diameter; cells spherical; heterocyst spherical or elliptical, somewhat broader than the vegetative cell, 6μ broad and 8μ long; resting spore absent,

Hab. Nos. 3, 7, 19, 20, 23.

Anabaena papillosa, HIRANO sp. nov.

Trichomata recta vel paulo flexuosa; cellulis vegetativis rotundo-oblongis, 7.5–8.8μ crassis, 8–10μ longis, contentu aerugineo-vacuolis gaseosis instructo; heterocystis cellulis vegetativis similibus, globosis 10.5–11μ crassis, 11–12μ longis, contentu homogeneo; hypnocystis cylindraceis vel elliptico-oblongis, papillosis utroque polo truncato-rotundatis, 13–16μ crassis, 35–55μ longis, plerumque solitariis, ab heterocystis distantibus, membrana dense et distincte papillosa. Pl. 1, fig. 6, 7.

Hab. No. 4.

Stigonemataceae

Stigonema mamillosum (LYNGB.) AG. in GEITLER, Süssw. -fl. **12**, p. 187, f. 226, 1925; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 416, f. 336, 337, 1930; DESIKACHARY, Cyanoph. p. 613, pl. 135, f. 3–6, 1959.

Hab. Nos. 19, 23. Distr. India, Japan, Europe, and Africa.

Stigonema ocellatum (DILLW.) THUR. in GEITLER, Süssw. -fl. **12**, p. 183, f. 228, 1925;

FRÉMY, Arch. Bot. **3**, Mém. 2, p. 399, 1930; DESIKACHARY, Cyanoph. p. 607, pl. 138, f. 2, 1959.

Trichomes 17–18μ broad excluding the sheath; heterocystis 16.5–17.5μ broad and 5.3μ long.

Hab. Nos. 20, 23. Distr. India, Japan, Europe and Africa.

Scytonemataceae

Scytonema mirabile (DILLW.) BORN. in GEITLER, Süssw. -fl. **12**, p. 272, f. 322, 1925; FRÉMY, Arch. Bot. **3**, Mém. 2, p. 319, f. 269, 1930; DESIKACHARY, Cyanoph. p. 483, pl. 91, f. 3, 1959.

Filament 5.3μ broad excluding the sheath. Pl. 1, fig. 16.

Hab. Nos. 20, 23. Distr. India, Japan, Europe and Africa.

CHRYSOPHYTA

Hydruraceae

Hydrurus foetidus KIRCHN. in Krypt. Schlesien II, p. 106, 1879; Pascher, Süssw. -fl. **2**, p. 87, f. 139, 1913.

Hab. Nos. 2, 8, 13, 14. Distr. Japan, Afghanistan, and Europe.

DIATOMEAE

Coscinodiscaceae

Melosira granulata (EHRENB.) RALFS in HUSTEDT, Süssw. -fl. **10**, p. 87, f. 44, 1930; Krypt. Fl. **7**: 1, p. 248, f. 104a–c, e, f, 1930.

Valves 22–23μ in diameter.

Hab. No. 23. Distr. Tibet, Pamir, Yunnan, Szechwan, Japan, Philippines, Afghanistan, Europe and Hawaii.

Cyclotella comta (EHRENB.) KÜTZ. in SCHMIDT, Atlas Diat. pl. 224, f. 1–4, 13–25, 1900; HUSTEDT, Krypt. Fl. **7**: 1, p. 354, f. 183 a–d, 1930; Süssw. -fl. **10**, p. 103, f. 69, 1930; SKVORTZOW, Philip. Journ. Sci. **62**, p. 192, 1937.

Valves 11–18.5μ in diameter. Pl. 4, fig. 24.

Hab. Nos. 19, 20. Distr. Cosmopolitan.

Fragilariaceae

Tabellaria flocculosa (ROTH) KÜTZ. in V. HEURCK, Synop. Diat. Belg. pl. 52, f. 10–12,

1881 ; SCHMIDT, Atlas Diat. pl. 269, f. 14-19, 22, 23, 27-30, 1911 ; HUSTEDT, Krypt. Fl. **7** : 2, p. 28, f. 558, 1931 ; SKVORTZOW, Philip. Journ. Sci. **61**, p. 14, pl. 1, f. 16, 1936.

Valves 73-83μ long, 9.5-10μ broad and striae 12-13 in 10μ.

Hab. Nos. 3, 5, 7, 16, 18, 19, 20, 22, 23. Distr. Tibet, Pamir, Yunnan, Szechwan, Japan, Philippines, Java, Celebes, Afghanistan, Europe, U. S. A., and Greenland.

Diatoma elongatum (LYNGB.) AG. var. **tenuis** (AG.) V. H. in HUSTEDT, Süssw. -fl. **10**, p. 128, f. 112, 1930 ; Krypt. Fl. **7** : 2, p. 100, f. 629d-g, 1931 ; FOGED, Medd. om Gronl. **147** : 10, p. 27, pl. 1, f. 1, 1953 ; HIRANO, Res. Kyoto Univ. Sci. Exped. Karak. Hind. **3**, p. 180, pl. 2, f. 1, 2, 1964.

Valves 22-23μ long, 5μ broad. Pl. 4, fig. 13.

Hab. No. 11. Distr. Tibet, Afghanistan, Europe, Greenland, and Africa.

Diatoma hiemale (LYNGB.) HEIB. in. HUSTEDT, Süssw. -fl. **10**, p. 129, f. 115, 1930 ; Krypt. Fl. **7** : 2, p. 102, f. 631a-d, 1931 ; SKVORTZOW, Philip. Journ. Sci. **61**, p. 14, pl. 1, f. 24, pl. 2, f. 34, pl. 10, f. 13, 1936 ; HIRANO, Res. Kyoto Univ. Sci. Exped. Karak. Hind. **3**, p. 181, 1964.

Valves 39.5-41μ long, 6.5-8.5μ broad. Pl. 4, fig. 23.

Hab. Nos. 5, 12, 16. Distr. Tibet, Pamir, Yunnan, Szechwan, Japan, Afghanistan, Asia Minor, Europe, and U. S. A.

var. **mesodon** (EHRENB.) GRUN. in V. HEURCK, Synop. Diat. Belg. pl. 51, f. 3, 4, 1881 ; MAYER, Krypt. Forsch. no. 4, p. 196, pl. 5, f. 34-36, 1919 ; HUSTEDT, Süssw. -fl. **10**, p. 129, f. 116, 1930 ; Krypt. Fl. **7** : 2, p. 103, f. 631e-h, 1931 ; SKVORTZOW, Philip. Journ. Sci. **61**, p. 14, pl. 1, f. 13, pl. 9, f. 18, pl. 10, f. 25, 1936 ; HIRANO, Res. Kyoto Uuiv. Sci. Exped. Karak. Hind. **3**, p. 181, pl. 2, f. 6, 1964.

Valves 12-16μ long, 7.7-8.5μ broad. Pl. 4, fig. 15, 16.

Hab. Nos. 3, 8, 11, 16, 22. Distr. India, Tibet, Pamir, Yunnan, Szechwan, Japan, Thailand, Afghanistan, Europe, and U. S. A.

Diatoma vulgare BORY var. **linearis** GRUN. in V. HEURCK, Synop. Diat. Belg. pl. 50, f. 7, 8, 1881 ; HUSTEDT, Süssw. -fl. **10**, p. 127, f. 108, 1930 ; Krypt. Fl. **7** : 2, p. 98, f. 628n 1931 ; SKVORTZOW, Philip. Journ. Sci. **61**, p. 14, pl. 10, f. 7, 1936 ; PATRICK, Monogr. Acad. Nat. Sci. Philad. p. 111, pl. 2, f. 12, 1966.

Valves 56μ long and 10.5μ broad. Pl. 4, fig. 7.

Hab. Nos. 9, 11. Distr. Europe, U. S. A., and Japan.

Ceratoneis arcus (EHRENB.) KÜTZ. var. **recta** (CLEVE) KRASSKE in KOBAYASHI, Journ. Jap. Bot. **40**, p. 126, f. 1-5, 1965. ——*C. recta* (SKVORTZOW) IWAHASHI in Journ. Jap. Bot. **12**, p. 391, f. 1a-c, 1936. ——*Ceratoneis amphioxys* RABENH. var. *recta* SKVORTZOW in Proc. Sung. R. Biol. Stat. **1** : 5, p. 8, pl. 1, f. 11, 1928.

Valves 39-56μ long, 6.5-7μ broad and striae 12 in 10μ. Pl. 4, fig. 6, 21.

Hab. Nos. 9, 11, 12. Distr. Japan and Manchuria.

SKVORTZOW reported *Ceratoneis arcus* KÜTZ. var. *amphioxys* (RAB.) HUSTEDT from Lake Kizaki, Japan but the valves of his specimens are slightly arcuate so that the present Himalayan specimens are distinguished from the specimens of Lake Kizaki by the form of valve. *Synedra vaucheriae* also resembles the present specimens, but the breadth of valves of the present specimens is broader than those of the *S. vaucheriae*.

Fragilaria capucina DESM. in V. HEURCK, Synop. Diat. Belg. pl. 45, f. 2, 1881; SCHMIDT, Atlas Diat. pl. 298, f. 14, 17–22, 29–36, 1913; HUSTEDT, Süssw. -fl. **10**, p. 138, f. 126, 1930; Krypt. Fl. **7**: 2, p. 144, f. 659a–e, 1931; SKVORTZOW, Philip. Journ. Sci. **61**, p. 16, pl. 1, f. 21, 1936; A. CLEVE, K. V. A. Handl. **4**: 1, p. 45, f. 357a–c, 1953; FOGED, Medd. om Gronl. **147**: 10, p. 28, pl. 1, f. 17, 1953.

Valves 24–36μ long, 3.4μ broad.

Hab. Nos. 3, 22. Distr. Pamir, Szechwan, Japan, Afghanistan, Europe, Greenland and U. S. A.

var. **lanceolata** GRUN. in SCHMIDT, Atlas Diat. pl. 298, f. 42–46, 1913; HUSTEDT, Süssw. -fl. **10**, p. 138, f. 127, 1930; Krypt. Fl. **7**: 2, p. 144, f. 659f, g, 1931; A. CLEVE, K. V. A. Handl. **4**: 1, p. 46, f. 357f–j, 1953; FOGED, Medd. om Gronl. **147**: 10, p. 28, pl. 1, f. 16, 1953.

Valves 42.5–44μ long, 5μ broad, and striae ca. 15 in 10μ.

Hab. No. 8. Distr. Tibet, Celebes, Europe, and Greenland. Pl. 4, fig. 37.

Synedra rumpens KÜTZ. in V. HEURCK, Synop. Diat. Belg. pl. 40, f. 14, 1881; HUSTEDT, Süssw. -fl. **10**, p. 156, f. 175, 1930; Krypt. Fl. **7**: 2, p. 207, f. 697a, b, 1932; A. CLEVE, K. V. A. Handl. **4**: 1, p. 41, f. 352a, 1953 (as var. genuina).

Valves 52–54μ long, 1.7μ broad.

Hab. Nos. 5, 7. Distr. Yunnan, Celebes, Philippines, Europe, Greenland and U. S. A.

Synedra ulna (NITZSCH) EHRENB. in V. HEURCK, Synop. Diat. Belg. pl. 38, f. 2, 7, 13, 1881; SCHMIDT, Atlas Diat. pl. 301, f. 1–26, pl. 302, f. 1–17, 19–22, pl. 303, f. 1–4, 1914; HUSTEDT, Krypt. Fl. **7**: 2, p. 195, f. 691A, a–c, 1932; SKVORTZOW, Philip. Journ. Sci. **61**, p. 18, pl. 1, f. 36, pl. 3, f. 8, 1936.

Valves 114–118μ long, 8μ broad. Pl. 5, fig. 1.

Hab. No. 3. Distr. Cosmopolitan.

var. **ramesi** (HEIB. & PERAG.) HUSTEDT in Süssw. -fl. **10**, p. 152, f. 163, 1930; SKVORTZOW, Philip. Journ. Sci. **61**, p. 18, pl. 1, f. 37, 1936; PATRICK, Diat. U. S. **1**, p. 153, pl. 6, f. 9, 1966.

Valves 40–42μ long, 8.5–9μ broad. Pl. 5, fig. 2.

Hab. No. 3. Distr. Szechwan, Japan, Afghanistan, Europe and U. S. A.

Eunotiaceae

Eunotia arcus EHRENB. in V. HEURCK, Synop. Diat. Belg. pl. 34, f. 2, 3, 1881; SCHMIDT,

Atlas Diat. pl. 274, f. 33-43, 45, 48-55, 1911 ; HUSTEDT, Süssw. -fl. **10**, p. 175, f. 216, 1930 ; Krypt. Fl. **7** : 2, p. 282, f. 748a-c, 1932 ; FOGED, Medd. om Gronl. **147** : 10, p. 31, pl. 1, f. 18, 20, 1953.

Valves 38-54μ long, 7-9.7μ broad, and striae 10-12 in 10μ. Pl. 4, fig. 19, 20.

Hab. Nos. 3, 20. Distr. Pamir, Yunnan, Szechwan, Afghanistan, Europe, Greenland and U. S. A.

Eunotia lunaris (EHRENB.) GRUN. in SCHMIDT, Atlas Diat. pl. 269, f. 38-44, 1911 ; HUSTEDT, Süssw. -fl. **10**, p. 183, f. 249, 1930 ; Krypt. Fl. **7** : 2, p. 302, f. 769a, d, e, 1932 ; SKVORTZOW, Philip. Journ. Sci. **61**, p. 21, pl. 1, f. 44, 1936.

Valves 88.5-105.5μ long, 3.7-5μ broad, and striae 11-12 in 10μ.

Hab. No. 16. Distr. Tibet, Burma, Thailand, Pamir, Yunnan, Celebes, Philippines, Japan, Afghanistan, Europe, Greenland and U. S. A.

Eunotia nepalense HIRANO, sp. nov.

Valvae parvae subarcuatae sed rectae in medio, leviter recurvatae ad apicem, margine ventrali et dorsali in media parte valvae recta et parallela, apicibus rotundatis retroflexisque non sive levissime capitatis, noduli terminales in relatione magni in margine ventrali polos valvarum distantes, striae transapicales regulariter ad polos versus non densior distributae, distinctae, ca 15 in 10μ. Longitudo valvarum 47-48μ, latitudo 5μ. Pl. 4, fig. 5.

Hab. No. 3.

Eunotia papilio (GRUN.) HUSTEDT in Naturw. Unters. Sarek. Geb. **3**, p. 543, pl. 18, f. 20, 21, 1924 ; Süssw. -fl. **10**, p. 173, f. 209, 1930 ; FOGED, Medd. om Gronl. **128** : 7, p. 36, pl. 3, f. 1, 2, 1955.

Valves 37-38μ long, 17.6-18μ broad, and striae 9-10 in 10μ. Pl. 4, fig. 32, 33.

Hab. No. 23. Distr. Japan, Europe and Greenland.

Eunotia pectinalis (DILLW. ?KG.) RABENH. in V. HEURCK, Synop. Diat. Belg. pl. 33, f. 16-18, 1881 ; SCHMIDT, Atlas Diat. pl. 271, f. 10, 11, 15, 1911 ; HUSTEDT, Süssw. -fl. **10**, p. 180, f. 237, 1930 ; Krypt. Fl. **7** : 2, p. 296, f. 763a, k, 1932.

Valves 57-58μ long, 6.7-7μ broad, and striae 9-10 in 10μ.

Hab. No. 16. Distr. Tibet, Celebes, Philippines, Europe, Greenland and U. S. A.

var. **minor** (KÜTZ.) RABENH. in HUSTEDT, Süssw. -fl. **10**, p. 182, f. 238, 1930 ; Krypt. Fl. **7** : 2, p. 298, f. 763d-f, 1932 ; SKVORTZOW, Philip. Journ. Sci. **61**, p. 22, pl. 1, f. 30, 1936 ; A. CLEVE, K. V. A. Handl. **4** : 1, p. 84, f. 409f, 1953.

Valves 23-42μ long, 7-8.5μ broad, and striae 17-18 in the middle and 20-23 near the end. Pl. 4, fig. 17, 18.

Hab. No. 16. Distr. Tibet, Pamir, Thailand, Mongolia, Japan, Philippines, Celebes, Afghanistan, Europe, Greenland, and U. S. A.

var. **undulata** RALFS in SCHMIDT, Atlas Diat. pl. 271, f. 26–28, 1911 ; HUSTEDT, Süssw. fl. **10**, p. 182, f. 240, 1930 ; Krypt. Fl. **7** : 2, p. 298, f. 763i, 1932 ; A. CLEVE, K. V. A. Handl. **4** : 1, p. 86, f. 409r, 1953.

Valves 57–60μ long, 9.7–10μ broad, and striae 9–10 in 10μ. Pl. 4, fig. 4.

Hab. No. 3. Distr. Java, Philippines, and Europe.

Eunotia praerupta EHRENB. var. **bidens** GRUN. in HUSTEDT, Süssw. -fl. **10**, p. 174, f. 213, 1930 ; Krypt. Fl. **7** : 2, p. 281, f. 747A, i–m, 1932 ; PATRICK, Diat. U. S. **1**, p. 194, pl. 10, f. 13, 1966.

Valves 59–75μ long, 13.5–14μ broad, and striae 9–12 in 10μ. Pl. 4, fig. 2, 3.

Hab. No. 23. Distr. Europe, Greenland and U. S. A.

Eunotia tschirchiana O. MÜLL. in HUSTEDT, Arch. Hydrobiol. Suppl. **15**, p. 173, pl. 12, f. 23–29, 1937 ; FOGED, Biol. Skr. Det. Kongl. Dansk. Vidensk. Selsk. **11** : 1, p. 43, pl. 1, f. 14, 1959 ; HIRANO, Res. Kyoto Univ. Sci. Exped. Karak. Hind. **8**, p. 24, pl. 3, f. 19, 1966.

Valves 42–44μ long, 8.5–9μ broad, and striae 12 in centre and 20–24 near the end in 10μ. Pl. 4, fig. 31.

Hab. No. 22. Distr. Afghanistan, Java, Sumatra, Celebes and Philippines.

Eunotia valida HUSTEDT in Süssw. -fl. **10**, p. 178, f. 229, 1930 ; Krypt. Fl. **7** : 2, p. 288, f. 754, 1932 ; PATRICK, Proc. Acad. Nat. Sci. Philad. **88**, p. 376, 1936 ; SKVORTZOW, Philip. Journ. Sci. **61**, p. 22, pl. 1, f. 41, 1936 ; HIRANO, Nat. Life SE. Asia **5**, p. 17, 1967.

Valves 110–167μ long, 6.5–7μ broad, and striae 10–12 in 10μ. Pl. 4, fig. 1.

Hab. No. 20. Distr. Thailand, Borneo, Malaya, Japan, and Europe.

Achnanthaceae

Cocconeis placentula (EHRENB.) HUSTEDT var. **lineata** (EHRENB.) CLEVE in V. HEURCK, Synop. Diat. Belg. pl. 30, f. 31, 32, 1881 ; HUSTEDT, Süssw. -fl. **10**, p. 190, f. 262, 1930 ; Krypt. Fl. **7** : 2, p. 348, f. 802d, 1933 ; SKVORTZOW, Philip. Journ. Sci. **61**, p. 22, pl. 2, f. 5, 1936.

Valves 23–24μ long, 14.3–14.6μ broad. Pl. 5, fig. 9.

Hab. No. 11. Distr. Japan, Java, Afghanistan, Europe, Greenland and U. S. A.

Achnanthes exigua GRUN. var. **constricta** TORKA in HUSTEDT, Süssw. -fl. **10**, p. 202, f. 287, 1930 ; Krypt. Fl. **7** : 2, p. 386, f. 832g, 1933 ; FOGED, Biol. Skr. Det. Kongel. Dansk. Vidensk. Selsk. **11** : 1, p. 44, pl. 2, f. 1, 1959.

Valves 17–18μ long, 6.8–7μ broad, and striae 18–20 in 10μ. Pl. 5, fig. 8.

Hab. No. 3. Distr. Szechwan, Afghanistan, Europe, and Africa.

Achnanthes inflata (KÜTZ.) GRUN. in HUSTEDT, Süssw. -fl. **10**, p. 209, f. 307, 1930 ; Krypt. Fl. **7** : 2, p. 421, f. 873, 1933.

Valves 66–68μ long, 17–17.6μ broad, and striae 7–8 in 10μ.

Hab. No. 3. Distr. Philippines, Europe, Hawaii, and U. S. A.

Achnanthes kryophila Boye-Peters. in Medd. om Gronl. **64**, p. 316, f. 6, 1924; HUSTEDT, Krypt. Fl. **7**: 2, p. 403, f. 854, 1933; FOGED, Medd. om Gronl. **128**: 7, p. 40, pl. 4, f. 18, 19, 1955.

Valves 21.3–22μ long, 7.3μ broad, and striae 9–10 in 10μ. Pl. 4, fig. 30.

Hab. No. 3. Distr. Europe and Greenland.

Achnanthes lanceolata (BRÉB.) GRUN. in V. HEURCK, Synop. Diat. Belg. pl. 27, f. 8–11, 1881; HUSTEDT, Süssw. -fl. **10**, p. 207, f. 306a, 1930; Krypt. Fl. **7**–2, p. 408, f. 863a–d, 1933; SKVORTZOW, Publ. Mus. Hoangho Paiho no. **36**, p. 38, pl. 9, f. 14, 1935; Philip. Journ. Sci. **61**, p. 26, pl. 2, f. 11, 12, 1936.

Valves 17–18.5μ long, 5.4μ broad, and striae 11–12 in 10μ.

Hab. No. 16. Distr. Tibet, Pamir, Japan Europe. Cosmopolitan.

Naviculaceae

Frustulia rhomboides (EHRENB.) De TONI var. **saxonica** (RAB.) De TONI in V. HEURCK, Synop. Diat. Belg. pl. 17, f. 4, 1880; HUSTEDT, Süssw. -fl. **10**, p. 221, f. 325, 1930; Krypt. Fl. **7**: 2, p. 729, f. 1099a, 1937.

Valves 56–58μ long, 13–13.4μ broad.

Hab. No. 23. Distr. Cosmopolitan.

Frustulia vulgaris (THWAITES) De TONI in SCHMIDT, Atlas Diat. pl. 369, f. 8, 1930; HUSTEDT, Süssw. -fl. **10**, p. 221, f. 327, 1930; Krypt. Fl. **7**: 2, p. 730, f. 1100a, 1937.

Valves 132–134μ long, 26–26.5μ broad, and striae 9–10 in 10μ.

Hab. No. 20. Distr. Yunnan, Philippines, Japan, Afghanistan, Europe, Greenland, Hawaii and U. S. A.

Neidium iridis (EHRENB.) CLEVE in SCHMIDT, Atlas Diat. pl. 49, f. 2, 1886; HUSTEDT, Süssw. -fl. **10**, p. 245, f. 379, 1930; A. CLEVE, K. V. A. Handl. **5**: 4, p. 119, f. 1174a, b, 1955 (as var. genuinum MAYER).

Valves 50–65μ long, 12–14.5μ broad, and striae 12–14 in 10μ.

Hab. Nos. 11, 23. Distr. Java, Sumatra, Philippines, Japan and Europe.

Diploneis elliptica (KÜTZ.) CLEVE in SCHMIDT, Atlas Diat. pl. 7, f. 29, 32, 1875; HUSTEDT, Süssw. -fl. **10**, p. 250, f. 395, 1930; Krypt. Fl. **7**: 2, p. 690, f. 1077a, 1937; A. CLEVE, K. V. A. Handl. **4**: 5, p. 77, 1953.

Valves 37–38μ long, 18.5–19μ broad, and striae 9–10 in 10μ.

Hab. No. 3. Distr. Cosmopolitan.

Stauroneis phoenicenteron EHRENB. var. **lanceolata** (KÜTZ.) DIPPL. in A. CLEVE, K.

V. A. Handl. **4**: 5, p. 210, f. 944d, 1953.

Valves 97–105, 4μ long, 18.7–19.6μ broad, and striae 14–15 in 10μ. Pl. 5, fig. 5.

Hab. Nos. 20, 22. Distr. Europe.

Anomoeoneis exilis (KÜTZ.) CLEVE var. **lanceolata** A. MAYER in HUSTEDT, Süssw. -fl. **10**, p. 264, 1930; SKVORTZOW, Philip. Journ. Sci. **62**, p. 200, pl. 2, f. 2, 1937; HUSTEDT, Krypt. Fl. **7**: 2, p. 752, f. 1114d, 1959 (as forma).

Valves 39–40μ long, 7.5μ broad, and striae 16–17 in 10μ. Pl. 5, fig. 15, 16.

Hab. No. 16. Distr. Japan and Europe.

Anomoeoneis serians (BRÉB.) CLEVE var. **brachysira** (BRÉB.) CLEVE in HUSTEDT, Süssw. -fl. **10**, p. 264, f. 427, 1930; Krypt. Fl. **7**: 2, p. 748, f. 1112e–h, 1959.

Valves 24–35.7μ long, 6.5–7.7μ broad, and striae 17–18 in 10μ. Pl. 5, fig. 10.

Hab. Nos. 3, 11, 20. Distr. Philippines, Hawaii and Europe.

forma **thermalis** (GRUN.) HUSTEDT in Süssw. -fl. **10**, p. 264, f. 428, 1930.

Valves 27μ long, 6.8μ broad. Pl. 5, fig. 14.

Hab. No. 3. Distr. Europe.

Navicula cryptocephala KÜTZ. in V. HEURCK, Synop. Diat. Belg. pl. 8, f. 1, 5, 1881; SCHMIDT, Atlas Diat. pl. 272, f. 35–37, 1911; HUSTEDT, Süssw. -fl. **10**, p. 295, f. 496, 1930; SKVORTZOW, Philip. Journ. Sci. **61**, p. 36, pl. 10, f. 3, 1936.

Valves 28–34μ long, 5–6.8μ broad, and striae 15–17 in 10μ.

Hab. Nos. 3, 7, 11. Distr. Cosmopolitan.

Navicula lanceolata (AG.) KÜTZ. in SCHMIDT, Atlas Diat. pl. 47, f. 49, 1886; HUSTEDT, Süssw. -fl. **10**, p. 305, f. 540, 1930; A. CLEVE, K. V. Akad. Handl. **4**: 5, p. 134, f. 772a, b, 1953 (as var. genuina A. Cl.)

Valves 35–36μ long, 8–8.3μ broad.

Hab. No. 20. Distr. Japan, Philippines, Celebes, Sumatra and Europe.

Navicula pupula KÜTZ. var. **bacillarioides** GRUN. in A. CLEVE, K. V. Akad. Handl. **4**: 5, p. 187, f. 890g, 1953.

Valves 29–30μ long, 8.5μ broad, and striae ca. 18 in 10μ. Pl. 5, fig. 13.

Hab. No. 22. Distr. Europe.

Navicula siofokensis PANT. in A. CLEVE, K. V. Akad. Handl. **4**: 5, p. 145, f. 799a, b, 1953 (as var. genuina A. Cl.)

Valves 56–57μ long, 14.5–15μ broad, and striae 9–10 in 10μ. Pl. 5, fig. 21.

Hab. No. 3. Distr. Europe.

The present specimens coincide well with the forms reported by SKVORTZOW from Lake Baikal, named *Navicula placentula* var. *jenisseyensis* (GRUN.) MEISTER. The valve shape of *N. placentula* is somewhat long elliptical and with protracted ends so that

the lateral margin shows some retuseness near the end of both side, while the shape of *N. siofokensis* is long rhomboidal, and the lateral margin straight, and the valves attenuate uniformly toward the end. The central area of valves of *N. placentula* and the manner of alternating disposition of long and short striae in this place are distinguished from *N. siofokensis* by the different form of the central area and the disposition of striae. SKVORTZOW reported *N. reinhardi* similar to the present specimens from North Manchuria, but the striae of *N. reinhardi* are convergent near the end of valve, while those of the present specimens are divergent.

Pinnularia biceps GREGORY in A. CLEVE, K. V. Akad. Handl. **5**: 4, p. 62, f. 1088a, c, d, 1955 (as var. typica A. CL.).

Valves 56–57μ long, 11μ broad, and striae 13–16 in 10μ. Pl. 5, fig. 17.

Hab. No. 11. Distr. Europe.

Pinnularia borealis EHRENB. in HUSTEDT, Süssw. -fl. **10**, p. 326, f. 597, 1930; A. CLEVE, K. V. Akad. Handl. **5**: 4, p. 32, f. 1037a–c, 1955.

Valves 34–38μ long, 8.5–10μ broad, and costae 9 in 10μ. Pl. 5, fig. 18.

Hab. Nos. 3, 7, 23. Distr, Pamir, Japan and Europe.

Pinnularia braunii (GRUN.) CLEVE in A. CLEVE, K. V. Akad. Handl. **5**: 4, p. 24, f. 1020 a, b, 1955 (as var. genuina A. Cl.).

Valves 34–34.5μ long, 7–7.3μ broad, and striae 12 in 10μ.

Hab. No. 7. Distr. Java, Bali, Philippines and Europe.

Pinnularia crucifera A. CLEVE var. **elongata** A. CLEVE in K. V. Akad. Handl. **5**: 4, p. 36, f. 1044a–f, 1955.

Valves 64.6–90μ long, 10–12μ broad, and striae 12 in 10μ. Pl. 5, fig. 3.

Hab. Nos. 16, 18, 19. Distr. Europe.

Pinnularia hustedtii MEISTER in Ber. Schweiz Bot. Ges. **44**, p. 102, pl. 9, f. 82, 1934.

var. **rangtangense** HIRANO, var. nov.

Valva lineari sed leviter inflata ad centrum, apicibus late rotundatis et leviter capitatis. Area axiali angusta sed leviter dilatata ad apices, amplificante gradatim in aream latam quae conjungit cum area media formare fasciam latam, transversam. Raphe recta, fissuris terminalibus magnis et distinctis. Striis valide radiatis in media parte valvae et convenientibus ad apices. Striis, ca. 12 in 10μ. Longitudo, 236–240μ. Latitudo, 25–25.5μ.

Hab. No. 11.

Pinnularia macilenta (EHRENB.) CLEVE in SCHMIDT, Atlas Diat. pl. 310, f. 3, 4, 1914; HUSTEDT, Süssw. -fl. **10**, p. 331, f. 613, 1930; SKVORTZOW, Philip. Journ. Sci. **61**, p. 279, 1936; A. CLEVE, K. V. A. Handl. **5**: 4, p. 40, f. 1051a, b, 1955 (as var. genuina A. Cl.).

Valves 116–118μ long, 17–17.4μ broad, and striae 9 in 10μ. Pl. 5, fig. 6.
Hab. No. 11. Distr. Japan, Europe, and U. S. A.

Pinnularia major (KÜTZ.) CLEVE in HUSTEDT, Süssw. -fl. **10**, p. 331, f. 614, 1930; SKVORTZOW, Philip. Journ. Sci. **61**, p. 43, pl. 6, f. 10, 1936; A. CLEVE, K. V. A. Handl. **5**: 4, p. 70, 1955.

Valves 100–105μ long, 25.5–26μ broad, and striae 6–7 in 10μ.
Hab. No. 20. Distr. Japan, Europe, and U. S. A.

var. **convergens** MEISTER in A. CLEVE, K. V. A. Handl. **5**: 4, p. 71, f. 1094i, 1955.
Valves 187–204μ long, 26.4–27μ broad, and striae 6 in 10μ.
Hab. Nos. 22, 23. Distr. Europe.

var. **linearis** CLEVE in SCHMIDT, Atlas Diat. pl. 42, f. 8–10, 1886; HUSTEDT, Süssw. -fl. **10**, p. 331, 1930; SKVORTZOW, Philip. Journ. Sci. **61**, p. 43, pl. 7, f. 11, 1936; A. CLEVE, K. V. A. Handl. **5**: 4, p. 70, f. 1094c–e, 1955.
Valves 228–230μ long, 32–32.5μ broad, and striae 6 in 10μ. Pl. 5, fig. 4.
Hab. Nos. 16, 19. Distr. Japan, Java, Sumatra, Europe and U. S. A.

Pinnularia microstauron (EHRENB.) CLEVE in HUSTEDT, Süssw. -fl. **10**, p. 320, f. 582, 1930; SKVORTZOW, Philip. Journ. Sci. **62**, p. 204, pl. 3, f. 11, 1937; A. CLEVE, K. V. A. Handl. **5**: 4, p. 55, f. 1073a–c, 1955 (as var. genuina O. MÜLL.); PATRICK, Diat. U. S. p. 597, pl. 55, f. 12, 1966.
Valves 39–41μ long, 8.5–8.7μ broad, and striae 15 in 10μ.
Hab. 11. Distr. Tibet, Pamir, Celebes, Philippines, Japan, Europe, U.S.A., and Hawaii.

Pinnularia stauroptera (RABENH.) CLEVE var. **subparallela** MAYER in A. CLEVE, K. V. A. Handl. **5**: 4, p. 68, f. 1091n, 1955.
Valves 63–83μ long, 9.4–10μ broad, and striae 9–12 in 10μ. Pl. 5, fig. 20.
Hab. Nos. 22, 23. Distr. Europe.

Pinnularia subcapitata GREGORY var. **lapponica** A. CLEVE in K. V. A. Handl. **5**: 4, p. 65, f. 1090i–m, 1955.
Valves 30.6–32μ long, 4.4μ broad, and striae 12 in 10μ. Pl. 5, fig. 11, 12.
Hab. No. 7. Distr. Europe.

Pinnularia viridis (NITZSCH) EHRENB. var. **fallax** CLEVE in SCHMIDT. Atlas Diat. pl. 43, f. 24, pl. 45, f. 10, 11, 1876; HUSTEDT, Süssw. -fl. **10**, p. 335, 1930; SKVORTZOW, Philip. Journ. Sci. **61**, p. 44, pl. 9, f. 7, pl. 12, f. 18, 1936; **62**, p. 206, 1937; A. CLEVE, K. V. A. Handl. **5**: 4, p. 74, f. 1103, h, i, 1955.
Valves 54.4–68μ long, 13.3–13.6μ broad, and striae 9 in 10μ. Pl. 5, fig. 19.
Hab. No. 20. Distr. Japan, Europe and U. S. A.

Cymbellaceae

Amphora coffaeiformis Ag. var. **borealis** (Kütz.) Cleve in A. Cleve, K. Vet Akad. Handl. **4** : 5, p. 97, f. 685b-d, 1953.

Valves 44-45μ long, 11μ broad. Pl. 4, fig. 14.

Hab. No. 3. Distr. Europe.

Cymbella aequalis W. Sm. var. **subaequalis** Grun. in A. Cleve, K. V. A. Handl. **5** : 4, p. 138, f. 1199h-l, 1955.

Valves 33-34μ long, 6.7-7μ broad, and striae 11-12 in 10μ. Pl. 4, fig. 27.

Hab. No. 8. Distr. Europe.

Cymbella amphicephala Näg. in Hustedt, Süssw. -fl. **10**, p. 355, f. 651, 1930; A. Cleve, K. V. A. Handl. **5** : 4, p. 151, f. 122a, b, 1955 (as var. genuina Mayer)

Valves 25.5-26μ long, 8.8-9μ broad. Valves asymmetric, ventral margin almost straight, dorsal margin convex, axial area narrow-linear and central area expanded. Valve outline resembles *C. ehrenbergii* forma *minor*, figured by Van Heurck, but is smaller. Pl. 4, fig. 28.

Hab. 7. Distr. Pamir, Tibet and Europe.

Cymbella aspera (Ehrenb.) Cleve var. **minor** (V. H.) Cleve in A. Cleve, K. V. A. Handl. **5** : 4, p. 167, f. 1256d, 1955.

Valves 68-94μ long, 17.6-27μ broad, and striae 11-12 in 10μ.

Hab. Nos. 3, 5, 6. Distr. Europe.

Cymbella cistula (Hempr.) Grun. in Hustedt, Süssw. -fl. **10**, p. 363, f. 676a, 1930; Skvortzow, Philip. J. Sci. **61**, p. 50, pl. 3, f. 20, 1936; A. Cleve, K. V. A. Handl. **5** : 4, p. 163, f. 1251a-c, 1955.

Valves 73-75μ long, 17-17.5μ broad, and striae 12 in 10μ. Pl. 4, fig. 25.

Hab. No. 8. Distr. Tibet, Pamir, Yunnan, Kwantung, Japan, Philippines, Europe and Africa.

Cymbella cymbiformis Kütz. var. **multipunctata** A. Cleve in K. V. A. Handl. **5** : 4, p. 16, f. 1246h, i, 1955.

Valves 108-128μ long, 23-23.4μ broad, and striae 12 in 10μ. Pl. 4, fig. 26.

Hab. No. 5. Distr. Yunnan, Szechwan, Kwantung, Europe, and Africa.

Cymbella ehrenbergii Kütz. in Schmidt, Atlas Diat. pl. 9, f. 6, 7, 1885; Hustedt, Süssw. -fl. **10**, p. 356, f. 656, 1930; A. Cleve, K. V. A. Handl. **5** : 4. p. 147, f. 1218a, b, 1955 (as var. typica A. Cl.)

Valves 132-134μ long, 33μ broad, and striae 9-10 in 10μ.

Hab. No. 11. Distr. Pamir, Yunnan, Szechwan, Japan and Europe.

Cymbella gracilis (RABENH.) CLEVE in HUSTEDT, Naturw. Unters. Sarek Schw-Lapl. **3**, p. 579, pl. 22, f. 12, 1924; Süssw. -fl. **10**, p. 359, f. 663, 1930; A. CLEVE, K. V. A. Handl. **5**: 4, p. 129, 1955.

Valves 26–32μ long, 5–6μ broad, and striae 18 in 10μ. Pl. 4, fig. 10.

Hab. Nos. 3, 7, 20, 23. Distr. Japan, Java, Sumatra, Bali, Celebes, Philippines, Europe, and Hawaii.

Cymbella lanceolata (EHRENB.) V. H. in Synop. Diat. Belg. pl. 2, f. 7, 1881; HUSTEDT, Süssw. -fl. **10**, p. 364, f. 679, 1930; A. CLEVE, K. V. A. Handl. **5**: 4, p. 165, f. 1254a, 1955.

Valves 133–165μ long, 26.5–29μ broad, and striae 10–12 in 10μ.

Hab. Nos. 20, 22, 23. Distr. Tibet, Burma, Yunnan, Sumatra, Celebes, Europe and Africa.

Cymbella naviculiformis AUERSW. in V. HEURCK, Synop. Diat. Belg. pl. 2, f. 5, 1881; HUSTEDT, Naturw. Unters. Sarek. Schw. -Lapl. **3**, p. 578, pl. 22, f. 10, 1924; Süssw. -fl. **10**, p. 356, f. 653, 1930; A. CLEVE, K. V. A. Handl. **5**:4, p. 152, f. 1226, 1955.

Valves 34–37μ long, 9.4–10μ broad, and striae 12 in dorsal side and 14 in ventral side in each 10μ. Pl. 4, fig. 29.

Hab. Nos. 7, 8. Distr. Japan, Szechwan, Java, Sumatra, Bali, and Europe.

The present specimens resemble *C. amphicephala*, but the ventral side of the present form is slightly convex not straight, and the end of the valve is not prostrated.

Cymbella ventricosa KÜTZ. in HUSTEDT, Süssw. -fl. **10**, p. 359, f. 661, 1930; SKVORTZOW, Philip. J. Sci. **61**, p. 48, pl. 11, f. 8, 14, 18, 1936; A. CLEVE, K. V. A. Handl. **5**: 4, p. 124, f. 1177a–c, 1955.

Valves 27–28μ long, 8.5μ broad, and striae 10–11 in 10μ. Pl. 5, fig. 22.

Hab. Nos. 6, 7, 11. Distr. Tibet, Pamir, Yunnan, Szechwan, Burma, Java, Sumatra, Japan, Europe, and Africa.

var. **minuta** (HILSE) V. H. in A. CLEVE, K. V. A. Handl. **5**: 4, p. 125, f. 1177g–i, 1955.

Valves 12–15μ long, 4.8–5.4μ broad, and striae 12–14 in 10μ.

Hab. Nos. 3, 7, 11, 20. Distr. Europe.

Gomphonema abbreviatum AG. ? KÜTZ. in HUSTEDT, Süssw. -fl. **10**, p. 379, f. 722, 1930; SKVORTZOW, Philip. J. Sci. **61**, p. 53, pl. 13, f. 42, 1936; A. CLEVE, K. V. A. Handl. **5**: 4, p. 195, f. 1298a, b, 1955 (as var. genuinum A. CL.).

Valves 27–28μ long, 6μ broad, and striae 9 in 10μ. Pl. 4, fig. 22.

Hab. No. 3. Distr. Szechwan, Japan and Europe.

Gomphonema gracile EHRENB. var. **naviculoides** (W. SM.) GRUN. in A. CLEVE, K. V.

A. Handl. **5**: 4, p. 186, f. 1281c, 1955.

Valves 32–44μ long, 6.5–8.5μ broad, and striae 12 in 10μ. Pl. 4, fig. 34–36.

Hab. Nos. 3, 20, 23. Distr. Japan, Philippines, Java, Bali, Celebes and Europe.

Gomphonema lanceolatum EHRENB. in HUSTEDT, Süssw. -fl. **10**, p. 376, f. 700, 1930; A. CLEVE, K. V. A. Handl. **5**: 4, p. 184, f. 1280a–e, 1955. (as var. genuinum A. CLEVE)

Valves 34–49μ long, 6–7μ broad, and striae 9–10 in 10μ. Pl. 4, fig. 38.

Hab. Nos. 5, 6, 20. Distr. Burma, Yunnan, Szechwan, Kwantung, Java, Sumatra, Philippines, Japan, Europe, Africa and Hawaii.

Gomphonema parvulum (KÜTZ.) GRUN. in Van HEURCK, Synop. Diat. Belg. pl. 25, f. 9, 1881; SCHMIDT, Atlas Diat. pl. 234, f. 2–13, 18, 19, 1902; HUSTEDT, Süssw. -fl. **10**, p. 372, f. 713a, 1930; A. CLEVE, K. V. A. Handl. **5**: 4, p. 177, f. 1269a–c, 1955. (as var. genuinum MAYER)

Valves 147–181μ long, 4.3μ broad, and striae 12 in 10μ.

Hab. No. 11. Distr, Tibet, Pamir, Yunnan, Szechwan, Burma, Japan, Philippines, Java, Sumatra, Africa and Europe.

Nitzschiaceae

Hantzschia amphioxys (EHRENB.) GRUN. var. **amphilepta** GRUN. in A. CLEVE, K. V. Akad. Handl. **3**: 3, p. 49, f. 1419u, uu, 1952.

Valves 44–58μ long, 6.7–7μ broad, and striae 15 in 10μ. Pl. 4, fig. 8.

Hab. Nos. 11, 16. Distr. Europe.

var. **pusilla** DIPPEL in A. CLEVE, K. V. Akad. Handl. **3**: 3, p. 48, f. 1419l, 1952.

Valves 34–41μ long, 5–7μ broad, and striae ca. 24 in 10μ. Pl. 4, fig. 11.

Hab. Nos. 3, 7. Distr. Europe.

Nitzschia goetzeana O. MÜLL. var. **gracilior** HUSTEDT in Hedw. **63**, p. 166, 1921; SCHMIDT, Atlas Diat. pl. 348, f. 8, 1922; SKVORTZOW, Publ. Musée Hoangho Paiho no. **36**, p. 35, pl. 8, f. 30, 1935.

Valves 51–53μ long, 5μ broad. Both sides of the valve are not parallel, but are narrow-lanceolate; both ends are prostrated and are terminated at the obtuse end. *Nitzschia palea* var. *sumatrana* and *N. philippinense* are related to the present form and are also similar to *N. okamurae* SKVORTZOW but these species are not explained respectively in establishing the new taxa or in distinguishing already known species from each other. Pl. 4, fig. 9.

Hab. No. 11. Distr. Mongolia and Africa.

Nitzschia hantzschiana RABENH. in SCHMIDT, Atlas Diat. pl. 349, f. 27–29, 1924; HUSTEDT. Süssw. -fl. **10**, p. 415, f. 797, 1930; A. CLEVE, K. V. Akad. Handl. **3**: 3, p. 87, f.

1498a-d, 1952 (as var. genuina A. Cl.).

Valves 25.5-26μ long, 4μ broad. Pl. 4, fig. 12.

Hab. No. 7. Distr. Europe.

Surirellaceae

Surirella linearis W. Sm. in Schmidt, Atlas Diat. pl. 23, f. 27, 1885; Hustedt, Süssw. -fl. **10**, p. 434, f. 837, 838, 1930; Skvortzow, Philip. J. Sci. **61**, p. 60, pl. 15, f. 11, 1936; A. Cleve, K. V. A. Handl. **3**: 3, p. 109, f. 1535a, b, 1952. (as var. genuina A. Cl.)

Valves 54-80μ long, 17-19μ broad.

Hab. Nos. 3, 18, 19, 20, 23. Distr. Tibet, Szechwan, Burma, Japan, and Europe.

CHLOROPHYTA

Volvocaceae

Pandorina morum (Müll.) Bory in Smith, Wisc. Geol. Nat. Hist. Surv. Bull. **57**, p. 95, pl. 16, f. 16, 17, 1920; Pascher, Süssw. -fl. **4**, p. 427, f. 388, 1927; Presctt, Alg. Great Lake Area p. 75, pl. 1, f. 23, 1951.

Hab. Nos. 6, 7. Distr. Cosmopolitan.

Palmellaceae

Gloeocystis gigas (Kütz.) Lagerh. in Smith, Wisc. Geol. Nat. Hist. Surv. Bull. **57**, p. 101, pl. 19, f. 2, 1920; Prescott, Alg. Great Lake Area p. 84, pl. 3, f. 16, 1951.

Hab. No. 20. Distr. Europe and U. S. A.

Tetrasporaceae

Schizochlamys delicatula West in Lemmermann, Süssw. -fl. **5**, p. 43, f. 19, 1915.

Diameter of colony 140μ; diam. of cell 8μ. Pl. 1, fig. 22.

Hab. No. 23. Distr. Europe.

Chlorococcaceae

Characium gracilipes Lambert in Brunthaler, Süssw. -fl. **5**, p. 84, f. 42, 1915; Smith, Wisc. Geol. Nat. Hist. Surv. Bull. **57**, p. 178, pl. 49, f. 20-24, 1920; Prescott, Alg. Great Lake Area p. 217, pl. 45, f. 16, 1951.

Cells 66-123μ long, 6-9.5μ broad. Pl. 1, fig. 8.

Hab. Nos. 23, 25. Distr. Japan, Europe and U. S. A.

Oocystaceae

Oocystis elliptica WEST forma **minor** WEST in BRUNTHALER, Süssw. -fl. **5**, p. 126, 1915; PRESCOTT, Alg. Great Lake Area p. 244, 1951.

Cells 22–24μ long and 10–12μ broad.

Hab. Nos. 18, 20, 23. Distr. Europe and U. S. A.

Oocystis solitaria WITTR. in BRUNTHALER, Süssw. -fl. **5**, p. 124, f. 94, 1915; PRESCOTT, Alg. Great Lake Area p. 247, pl. 54, f. 10, 1951.

Cells 39–40μ long, 22μ broad. Pl. 1, fig. 23.

Hab. No. 23. Distr. Europe and U. S. A.

Dictyosphaeriaceae

Dictyosphaerium pulchellum WOOD in BRUNTHALER, Süssw. -fl. **5**, p. 184, f. 277, 1915; SMITH, Wisc. Geol. Nat. Hist. Surv. Bull. **57**, p. 105, pl. 20, f. 13, pl. 21, f. 1, 1920; PRESCOTT, Alg. Great Lake Area p. 238, pl. 51, f. 5–7, 1951.

Hab. No. 24. Distr. Japan, Europe and U. S. A.

Hydrodictyaceae

Pediastrum boryanum (TURP.) MENEGH. in BRUNTHALER, Süssw. -fl. **5**, p. 100, f. 61a, 1915; SMITH, Wisc. Geol. Nat. Hist. Surv. Bull. **57**, p. 169, pl. 46, f. 2–7, 1920; PRESCOTT, Alg. Great Lake Area p. 222, pl. 47, f. 9, pl. 48, f. 1, 3, 1951.

Hab. No. 22. Distr. Cosmopolitan.

Pediastrum integrum NÄG. in BRUNTHALER, Süssw. -fl. **5**, p. 91, f. 51a, 1915; SMITH, Wisc. Geol. Nat. Hist. Surv. Bull. **57**, p. 168, pl. 45, f. 7, 1920; PRESCOTT, Alg. Great Lake Area p. 225, pl. 48, f. 9, 10, 1951.

Hab. No. 18. Distr. Cosmopolitan.

Coelastraceae

Scenedesmus ecornis (RALFS) CHODAT in SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**: 5, p. 66, pl. 10, f. 52, 1949; HIRANO, Nature Life Southeast Asia **5**, p. 36, 1967.

Hab. Nos. 7, 19, 20. Distr. Burma, Philippines, Asia Minor, Europe, Africa and New Zealand.

Chaetosphaeridiaceae

Chaetosphaeridium globosum (NORDST.) KLEBAHN in HEERING, Süssw. -fl. **6**, p. 144, f. 198, 1914; PRESCOTT, Alg. Great Lake Area p. 131, pl. 14, f. 6, 7, 1951.

Cells 9–11μ in diameter. Pl. 1, fig. 24.

Hab. Nos. 20, 21, 23. Distr. Europe and U. S. A.

Oedogoniaceae

Oedogonium acrosporum De BARY in HIRN, Act. Soc. Sci. Fenn. **3**, p. 244, pl. 41, f. 254, 255, 1900; HEERING, Süssw. -fl. **6**, p. 183, f. 253, 1914; TIFFANY, Oedog. p. 157, pl. 60, f. 589, 1930; GEMEINHARDT, Krypt. Fl. **12**, Abt. 4, p. 324, f. 391, 1939.

Vegetative cells 19–20μ in diameter, 54–58μ long; oogonia solitary, terminal, 37–38μ in diameter, 50–52μ long. Pl. 1, fg. 12.

Hab. No. 23. Distr. Europe, U. S. A., Manchuria and Madagascar.

Oedogonium curvum PRINGSHEIM in HIRN, Act. Soc. Sci. Fenn. **3**, p. 74, pl. 1, f. 3, 1900; TIFFANY, Oedog. p. 65, pl. 11, f. 103, 104, 1930; GEMEINHARDT, Krypt. Fl. **12**, Abt. 4, p. 88, f. 53, 54, 1939.

Vegetative cells 5.3–10μ in diameter, 40–47μ long; oogonia 24μ in diameter, 24μ long; oospores 22μ in diameter, 21.5μ long. Pl. 1, fig. 13.

Hab. No. 7. Distr. Europe and U. S. A.

Oedogonium rufescens WITTR. var. **exiguum** (ELFV.) TIFFANY in Oedog. p. 66, pl. 11, f. 106, 1930; GEMEINHARDT, Krypt. Fl. **12**, Abt. 4, p. 91, f. 58, 1939.

Vegetative cells 6.5–9μ in diameter, 40–49μ long; oogonia 26–27μ in diameter, 31–33μ long. Pl. 1, fig. 10.

Hab. Nos. 19, 20. Distr. Europe and U. S. A.

Oedogonium sociale WITTR. in HIRN, Act. Soc. Sci. Fenn. **3**, p. 92, f. 61, 1900; HEERING, Süssw. -fl. **6**, p. 193, f. 271, 1914; TIFFANY, Oedog. p. 67, pl. 11, f. 109, 1930; GEMEINHARDT, Krypt. Fl. **12**, Abt. 4, p. 92, f. 61, 1939.

Vegetative cells 12μ in diameter, 31–35μ long; oogonia 22–22.5μ in diameter, 28–30μ long. Pl. 1, fig. 9.

Hab. Nos. 5, 8, 19, 23. Distr. India, Tibet, Burma, Europe, and U. S. A.

Oedogonium suecicum WITTR. in HIRN, Act. Soc. Sci. Fenn. **3**, p. 82, pl. 2, f. 15, 1900; HEERING, Süssw. -fl. **6**, p. 193, f. 281, 1914; GEMEINHARDT, Krypt. Fl. **12**, Abt. 4, p. 95, f. 66, 1939; PRESCOTT, Alg. Great Lake Area p. 174, pl. 33, f. 4, 5, 1951.

Vegetative cells 8.7–9μ in diameter, 44–52μ long; oogonia 37μ in diameter, 35μ long; oospores 31–32μ in diameter. Pl. 1, fig. 11.

Hab. No. 23. Distr. Europe and U. S. A.

Gonatozygaceae

Gonatozygon monotaenium De BARY in WEST, Monogr. Brit. Desm. **1**, p. 30, pl. 1, f. 1–7, pl. 5, f. 5, 1904; GRÖNBLAD, Soc. Sci. Fenn. Comm. Biol. **10**: 5, p. 9, f. 1, 1948: HIRANO,

Contr. Biol. Lab. Kyoto Univ. **1**, p. 22, pl. 1, f. 1, 1955.

Cells 170–230μ long, 11–12.3μ broad, and apices 13–13.5μ.

Hab. Nos. 7, 18, 23. Distr. Burma, Szechwan, Thailand, Japan, Java, Sumatra, Europe, Greenland, and N. America.

Desmidiaceae

Closterium acerosum (SCHRANK) EHRENB. in WEST, Monogr. Brit. Desm. **1**, p. 146, pl. 18, f. 2–5, 1904; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 314, pl. 23, f. 11, 12, 1935.

Cells 770–785μ long and 61–62μ broad.

Hab. No. 22. Distr. Cosmopolitan.

Closterium calosporum WITTR. in WEST, Monogr. Brit. Desm. **1**, p. 138, pl. 16, f. 1–4, 1904; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 292, pl. 19, f. 1–3, 1935; FÖRSTER, Ergeb. Forsch.-Unters. Nep. Himal. p. 34, 1965.

Cell 136μ long and 16.7μ broad.

Hab. No. 7. Distr. Cosmopolitan.

var. **brasiliense** BÖRG. in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 294, pl. 19, f. 8, 1935; HIRANO, Contr. Biol. Lab. Kyoto Univ. **1**, p. 44, pl. 4, f. 11, 1955.

Cell 180μ long and 7.8μ broad.

Hab. No. 7. Distr. Japan, Europe, N. America, and Brazil.

Closterium cornu EHRENB. in WEST, Monogr, Brit. Desm. **1**, p. 157, pl. 20, f. 1–5, 1905; HIRANO, Fauna Flora Nep. Himal. p. 17, pl. 3, f. 7, 1955.

Hab. No. 6. Previously known to exist from Nepal Himalaya. Distr. Cosmopolitan.

Closterium dianae EHRENB. in WEST, Monogr, Brit. Desm. **1**, p. 130, pl. 15, f. 1–6, 1904; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 294, pl. 19, f. 9–11, 1935; HIRANO, Contr. Biol. Lab. Kyoto Univ. **1**, p. 45, pl. 3, f. 3, 4, pl. 4, f. 2, 1955.

Cells 210–234μ long and 14.3–14.7μ broad.

Hab. No. 23. Distr. Cosmopolitan.

Closterium gracile BRÉB. in WEST, Monogr. Brit. Desm. **1**, p. 166, pl. 21, f. 8–12, 1904; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 310, pl. 30, f. 7–9, 1935; HIRANO, Contr. Biol. Lab. Kyoto Univ. **1**, p. 35, pl. 6, f. 8–10, 1955.

Hab. No. 20. Distr. Cosmopolitan.

Closterium leibleinii KÜTZ. in WEST, Monogr. Brit. Desm. **1**, p. 141, pl. 16, f. 9–14, 1904; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 283, pl. 17, f. 5–7, 1935; HIRANO, Faun. Flor. Nepal Himal. p. 18, pl. 3, f. 11, 1955.

Cells 88–120μ long and 17.6–22μ broad.

Hab. Nos. 6, 7, 8. Distr. Cosmopolitan, known from Nepal Himalaya.

Closterium pseudolunula BORGE in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 305, pl. 22, f. 3, 1935; MESSIKOMMER, Viertelj. Naturf. Ges. Zurich **80**, p. 40, pl. 1, f. 3, 1935; KRIEGER & BOURRELLY, Erg. deutsch. Limn. Venez. -Exp. **1**, p. 146, pl. 1, f. 5, 1952.

Cells 324–360μ long and 47–48.4μ broad.

Hab. No. 7. Distr. Europe, Spitzbergen, and Venezuela.

Cosmarium abscissum GRÖNBL. var. **subetchachanense** GRÖNBLAD in Act. Soc. Faun. Flor. Fenn. **49**, p. 30, pl. 6, f. 20, 21, 30, 1921.

Cells 48–48.5μ long, 44–44.3μ broad, and isthmus 15–15.4μ broad. Semicells subsemicircular–subtrapeziform, lateral margin prominently undulate, apex without any undulation, granules are not distinct; semicells with two pyrenoids. The present specimens are similar to *C. vexatum*, but the apex of the semicell is narrower than those of *C. vexatum*, and the number of undulations in the lateral margin is five while the undulation number of Himalayan specimens is nine. The granules just above the isthmus shown in the *C. vexatum* are not seen in the centre of the semicell in the present specimens. Pl. 2, fig. 16.

Hab. No. 7. Distr. Finland.

Cosmarium asphaerosporum NORDST. var. **strigosum** NORDST. in BORGE, Ark. Bot. **23**A : 2, p. 37, pl. 2, f. 29, 1930; HIRANO, Contr. Biol. Lab. Kyoto Univ. **2**, p. 100, pl. 20, f. 11, 1956.

Cells 7.8–9.2μ long, 6.5–6.8μ broad, and isthmus 2–2.3μ broad.

Hab. No. 5. Distr. Japan, Manchuria, Europe, and Canada.

Cosmarium botrytis MENEGH. in WEST, Monogr. Brit. Desm. **4**, p. 1, pl. 96, f. 1, 2, 5–15, 1911; HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 182, pl. 27, f. 13, 1957; FÖRSTER, Ergeb. Forsch.-Unters. Nepal Himal. p. 38. pl. 3, f. 36, 1965.

Cells 68–71μ long, 5.3–5.8μ broad, and isthmus 17.4–17.7μ broad.

Hab. No. 19. Distr. Cosmopolitan.

var. **rangtangense** HIRANO, var. nov.

Semicellulae ovato-circulares, non pyramidatae, angulis basalibus late rotundatis, marginibus lateralibus convexis convergentibus ad apicem, apice paulo recto; membrana granulata, granulis parvis multis in serie oblique regulariter dispositis, cellulis 79–81μ longis et 61.5–63μ latis et 17.5–17.8μ isthmis. Pl. 3, fig. 16.

Hab. No. 22.

FÖRSTER reported *C. botrytis* similar to the present specimens from Himalaya, but the semicells of the present specimens obtained from Rangtang Himal are broader and the apex is not truncate, but the number of granules on the face of the semicell and its disposition are similar to each other.

Cosmarium connatum BRÉB. in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 25, pl. 67, f. 15–17, 1908 ; SKUJA, Nov. Act. Regn. Soc. Sci. Ups. ser. IV, **14** : 5, p. 119, 1949 ; HIRANO, Contr. Biol. Lab. Kyoto Univ. **2**, p. 88, pl. 16, f. 17, pl. 17, f. 8, 1956. Pl. 2 fig. 11.

Hab. No. 20. Distr. India, Burma, Java, Sumatra, China, Japan, Europe, Africa and N. America.

Cosmarium diplosporum (LUND.) LÜTKEM. in CARTER, Record Bot. Surv. India **9**, p. 289, 1926 ; HIRANO, Contr. Biol. Lab. Kyoto Univ. **2**, p. 79, pl. 15, f. 11, 1956.

forma **minor** HIRANO, f. nov.

Cellulae minores, 37–39μ longae et 17.4–17.6μ latae. Pl. 2, fig. 3.

Hab. No. 23.

The present form was considered in earlier times as a form of *Cylindrocystis* or *Penium*. Cells are elongate cylindrical and with a slight constriction in the middle, and the median constriction shows a broad retuseness. Semicells are slightly tumid in the middle, so that the lateral margin of the semicell is slightly convex. According to TEILING such a form was already reported by CUSHMANN as *Cylindrocystis americana* and by IRÉNÉE-MARIE from Canada as *Cyl. americana* var. *minor*, respectively. However, their forms are somewhat different from the present form in exhibiting an acute median constriction of cell. The forms reported by MESSIKOMMER from Switzerland as a form of *Penium* species correspond perhaps to the present Himalayan form.

Cosmarium formosulum HOFF. in WEST, Monogr. Brit. Desm. **3**, p. 240, pl. 88, f. 1–3, 1908 ; BORGE, Ark. Bot. **18** : 10, p. 8, pl. 1, f. 5, 1923 ; HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 197, pl. 28, f. 25, 1957.

Cells 37.4–39.6μ long, 31.7–33μ broad, and isthmus 9.7–11μ broad. Pl. 3, fig. 10, 14.

Hab. No. 7. Distr. Japan, China, Manchuria, Europe, and S. Africa.

Cosmarium garrolense ROY & BISSET in WEST, Monogr. Brit. Desm. **3**, p. 12, pl. 66, f. 7, 8, 1908 ; BORGE, Ark. Bot. **18** : 10, p. 8, pl. 1, f. 6, 1923 ; MESSIKOMMER, Viertelj. Nat. Ges. Zurich, **80**, p. 46, pl. 4, f. 32, 1935 ; SKUJA, Nov. Act. Regn. Soc. Sci. Ups. ser. IV, **14** : 5, p. 123, pl. 30, f. 30, 1949 ; RUZICKA, Prir. sbor. Ostrav. **17**, p. 43, pl. 1, f. 12, 1956.

Some of the present specimens have a truncate and retuse apex, and lateral margins bear 6 undulations on each side. Cells 25.7–26.4μ long, 22–22.4μ broad, and isthmus 7.8μ broad. Pl. 2, fig. 14.

Hab. No. 5. India, Burma, Szechwan, Europe, and U. S. A.

Cosmarium globosum BULNH. in WEST, Monogr. Brit. Desm. **3**, p. 29, pl. 68, f. 1, 2, 1908 ; HIRANO, Contr. Biol. Lab. Kyoto Univ. **2**, p. 82, pl. 16, f. 15, 16, 1956 ; FÖRSTER, Ergeb. Forsch.-Unters. Nepal Himal. p. 41, pl. 1, f. 33, 1965.

Cells 32–34μ long, 22–23μ broad, and isthmus 19.8–20μ broad.

Hab. No. 20. Distr. Cosmopolitan.

Cosmarium gostyniense (RACIB.) GRÖNBLAD in Act. Soc. Faun. Flor. Fenn. **49**, p. 38, pl. 7, f. 32, 33, 1921.

Cells 14–14.5μ long, 13–13.4μ broad, and isthmus 4.4μ broad. The outline of cells in the present specimens coincides well with the original description, but is smaller in size. The lateral margin is slightly divergent and somewhat retuse; the apex is broad, but is sometimes slightly retuse. Apical angles are obliquely truncate and slightly retuse. TURNER reported *C. umbonatum* in 1893 from India. The cells of his species are slightly longer in breadth, and the apex is slightly narrower. The present species differs from TURNER's by the larger ratio of length to breadth of cell, and they bear a narrower apex of cell. The present species also resembles *C. octagonum*, but the vertical view of the cell is not fusiform, as shown in *C. octagonum*. Pl. 3, fig. 11.

Hab. No. 20. Distr. Finland.

Cosmarium impressulum ELFV. in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 86, pl. 72, f. 14–18, 1908; MESSIKOMMER, Viertelj. Nat. Ges. Zurich **80**, p. 47, pl. 4, f. 34, 35, 1935; HIRANO, Faun Flor. Nepal Himalaya p. 22, 1955.

Cells 30–30.5μ long, 19.7–20.3μ broad and isthmus 7.8–8μ broad. Pl. 2, fig. 4.

Hab. No. 20. Distr. Cosmopolitan.

var. **johorense** BERNARD in Departm. agr. Indes. Nèerl. p. 44, pl. 3, f. 66, 67, 1909.

Cells 20–22μ long. 13.5–15μ broad, and isthmus 4.2–4.5μ broad. Pl. 2, fig. 5.

Hab. No. 7. Distr. Malaya.

The present forms are apparently similar to *C. undulatum* var. *crenulatum*, but are distinguished from that species in the following respects: the lateral margin and apex are not retuse, the length of each of the lateral margin is not equal to each other.

Cosmarium logiense BISSET in BORGE, Bih. K. Svensk Vet. Akad. Handl. **24**, Afd. III, no. 12, p. 19, pl. 1, f. 21, 1899; W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 163, pl. 80, f. 1, 2, 1908; HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 172, pl. 26, f. 17, 1957.

Cells 61–62μ long, 44–44.5μ broad, and isthmus 17.5–18μ broad. Pl. 3, fig. 8.

Hab. No. 23. Distr. Japan, Europe, New Foundland, and W. Indies.

The present species coincided well with figure 2 given by WEST in his monograph, but are slightly different by slightly larger sized granules.

Cosmarium lundellii DELP. var. **ellipticum** W. & G. S. WEST in Monogr. Brit. Desm. **2**. p. 138, pl. 57, f. 3, 4, 1905; HIRANO, Faun. Flor. Nepal Himalaya p. 23, 1955; SKUJA, Nov. Act. Regn. Soc. Sci. Ups. ser. IV, **14**: 5, p. 126, 1949.

Cells 58–60μ long, 43.5–44μ broad, and isthmus 17–17.7μ broad.

Hab. Nos. 12, 15. Distr. Nepal, Burma, Japan, Manchuria, Europe, and Canada.

Cosmarium margaritiferum MENEGH. in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 199, pl. 83, f. 4–11, 1908; HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 190, pl. 28, f. 3,

1957.

Hab. No. 20. Distr. Cosmopolitan.

Cosmarium meneghinii BRÉB. in W. & G. S. WEST, Monogr. Brit. Des. **3**, p. 90, pl. 72, f. 29–32, 1908.

forma **himalaica** HIRANO, forma nov.

Differt a typo cellulis cum marginibus superioribus levissime duobus undulatis, undulis superioribus minoribus, apicibus semicellularum leviter convexo-retusis. Cellulae 22–23μ longae, 15.4–15.7μ latae, lat. isth. 5.7–6μ. Pl. 2, fig. 13.

Hab. No. 7.

The present specimens obtained from Rangtang Himal do not perfectly coincide with the typical form of this species: they differ from the typical form especially by the shape of the upper half of the semicell. Upper lateral margin are convergent and retuse in the typical form, and the apex is truncate and retuse, while in the present specimens the upper lateral margin consists exactly of two parts: the lower lateral margin is distinct and retuse, the upper is small and the retuseness is not recognizable. In the majority of specimens, the upper lateral margin is straight and transfered to the apex in apical angles so that they are sometimes not recognizable between apex and upper lateral margin. The specimens shows the bearing of uppermost lateral margin similar to *C. impressulum*. The forms reported by MESSIKOMMER from Switzerland as *C. impressulum* are similar in appearance to the present form. MESSIKOMMER also reported *C. undulatum* var. *crenulatum* from Davos; his forms are similar to the present form, but distinguished from our forms by the shape of the apex. The lower lateral margin of the present forms is slightly divergent.

Cosmarium minimum W. & G. S. WEST var. **rotundatum** MESSIKOMMER in Beitr. geobot. Landes. **24**, p. 145, pl. 4, f. 17–19, pl. 5, f. 1–4, 1942; HIRANO, Contr. Biol. Lab. Kyoto Univ. **4**, p. 149, pl. 24, f. 31, 1957.

Cells 12.3–12.5μ long, 12.3–12.5μ broad, and isthmus 3.4–3.6μ broad. Pl. 3, fig. 9.

Hab. No. 19. Distr. Europe.

The present specimens resemble the form reported from Davos by MESSIKOMMER, but the present forms are different from his form in some respects. That is, the present forms bear perfectly closed sinus, and the cell length is quite equal to the width. The semicells are somewhat broader than those of the specimens from Davos. Semicells are not pyramidate. The present forms are similar to *C. subquadrans* in cell outline, but smaller than the British form. Lateral margin of semicell in *C. subquadrans* is slightly convergent.

Cosmarium norimbergense REINSCH forma **depressa** W. & G. S. WEST in SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**: 5, p. 130, pl. 30, f. 17, 18, 1949; HIRANO, Contr. Biol. Lab. Kyoto Univ. **4**, p. 142, pl. 24, f. 8, 9, 1957; CROASDALE, Trans. Amer. Micr. Soc.

84, p. 322, pl. 3, f. 17, 1965.

Cells 8.7–9μ long, 10.5–10.8μ broad, and isthmus 3μ broad.

Hab. No. 18. Distr. Burma, Thailand, Japan, Ceylon, Europe, N. America and Africa.

Cosmarium obtusatum SCHMIDLE in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 7, pl. 65, f. 13, 14, 1908; BORGE, Ark. Bot. **18**: 10, p. 10, pl. 1, f. 10, 1923; HIRANO, Fauna Flora Nepal Himalaya p. 24, 1955; SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**: 5, p. 131, pl. 30, f. 25, 27, 1949.

Hab. No. 20. Distr. Nepal, Burma, China, Japan, Manchuria, Siberia, Europe, N. America and Africa.

Cosmarium octagonum TURNER in K. Sv. Vet. Akad. Handl. **25**, p. 69, pl. 10, f. 12, 1893.

Cell 17.6μ long, 14μ broad and isthmus 4.4μ broad. Pl. 3, fig. 6.

Hab. No. 7. Distr. India.

The present specimens are slightly larger in form than those described by TURNER, and resemble *C. norimbergense* forma *depressa*. They are distinguished from his forms by bearing obliquely truncated apical angles. The specimens show two different forms: lateral margin and apex are retuse in some specimens, and other forms show straight lateral margin and apex. The present species should be compared with *C. angulosum*.

Cosmarium pachydermum LUND. var. **minus** NORDST. in W. & G. S. WEST, Trans. Linn. Soc. Bot. **6**, p. 162, 1902.

Cells 63.5–66μ long, 47.5–51μ broad, and isthmus 17–17.6μ broad. Pl. 2, fig. 2.

Hab. No. 15. Distr. Malaya and Ceylon.

The Himalayan specimens show some variations. Some of them resemble *C. lundellii* var. *ellipticum* and some resemble a small form of *C. pachydermum*, having broadly rounded basal angles and a thick wall. NORDSTEDT named such a small form of this species as var. *minus*.

Cosmarium pericymatium NORDST. var. **notabiliforme** INSAM & KRIEGER in Hedw. **76**, p. 105, pl. 3, f. 23, 1936.

Cells 37.5–38μ long, 24–24.5μ broad, and isthmus 19.7–20μ broad. Pl. 2, fig. 6.

Hab. No. 8. Distr. Europe.

The Himalayan forms obtained from Rangtang Himal are slightly longer in the cell form than those of the typical form and are subcylindrical. Semicells subquadrate-pyramidate, margin 12 crenate, lateral crenation five, including apical and basal angles, apex slightly convex and 4-crenate, the median two crenations out of these four crenations are somewhat elevated. The present specimens are more prominently crenated than those obtained and described from Tirol. CARTER reported a similar form to this

species as *C. pericymatium* from British Colombia, Canada, and that form has fewer lateral crenations than those of the present specimens. The Canadian form described and figured by CARTER seem to be somewhat different from the original typical form described by NORDSTEDT.

Cosmarium polonicum RACIB. in GRÖNBLAD, Act. Soc. Faun. Flor. Fenn. **47**, p. 46, pl. 5, f. 5, 1920; HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 180, pl. 27, f. 5, 1957.

Cells 26.5–27μ long, 24–24.5μ broad, and isthmus 8.5–9μ broad. Pl. 2, fig. 15.

Hab. No. 20. Distr. Japan and Europe.

Cosmarium praemorsum BRÉB. in. W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 196, pl. 84, f. 1–5, 1908; INSAM & KRIEGER, Hedw. **76**, p. 105, pl. 6, f. 3, 1936 (as forma).

Cells 48.5–53μ long, 39.5–42μ broad, and isthmus 12–13μ broad. Semicells truncate-reniform or subcircular, apex flattened. The granules on the face of the semicell are small and disposed roughly in somewhat concentric series, but gradually diminish towards the centre. The vertical view of the semicell is somewhat rhomboid-elliptic and slightly tumid at the middle on each side; the centre of the semicell is smooth. Pl. 3, fig. 1.

Hab. No. 7. Distr. Europe, Faeroes and E. Africa.

Cosmarium pseudoprotuberans KIRCHN. var. **angustius** NORDST. in K. Sv. Vet. Akad. Handl. **22**, p. 58, pl. 6, f. 15, 16, 1888; W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 56, 1908; HIRANO, Contr. Biol. Lab. Kyoto Univ. **2**, p. 105, pl. 20, f. 12, 1956.

Cells 33–35μ long, 26.5–31μ broad, and isthmus 8–8.5μ broad. Semicells of the present specimens are reniform, and the upper lateral margin is gradually transfered to the apex; and the form of this variety is not transversely hexagonal. Pl. 2, fig. 1.

Hab. Nos. 19, 20, 23. Distr. Japan, Europe and New Zealand.

Cosmarium quadratum RALFS in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 57, pl. 70, f. 6–8, 1908; FÖRSTER, Ergebn. Forsch. -Unters. Nepal Himalaya **2**, p. 44, pl. 3, f. 39, 40, 1965.

Cells 74.5–79μ long, 39–40μ broad, and isthmus 17.6–25μ broad.

Hab. Nos. 19, 20, 23. Distr. Nepal, China, Japan, Siberia, Europe, Iceland, Spitzbergen, Greenland, Novaya Zemlya and Alaska.

Cosmarium regnellii WILLE forma **minima** EICHL. & GUTW. in GRÖNBLAD, Act. Soc. Faun. Flor. Fenn. **49**, p. 40, pl. 7, f. 49, 50, 1921; MESSIKOMMER, Viertelj. Naturf. Ges. Zurich **80**, p. 49, pl. 4, f. 43, 44, 1935.

Cells 17–18μ long, 15–15.5μ broad, and isthmus 4–4.3μ broad.

Hab. Nos. 5, 7, 20. Distr. Nepal, Japan, Europe and U. S. A.

The present specimens coincided with the British forms in size and in outline of cells, but the lateral angles are not so projected as those of the British description.

The upper lateral margins are retuse in general, but in some specimens this point is not so distinct. The lower lateral margin is longer than that of the upper, and is divergent.

Cosmarium regulare WILLE in Bih. K. Sv. Vet. Akad. Handl. 8, p. 16, pl. 1, f. 34, 1884; W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 89, pl. 72, f. 25–28, 1908; SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**: 5, p. 139, pl. 29, f. 4, 1949; FÖRSTER, Ergebn. Forsch.-Unters. Nepal Himalaya **2**, p. 45, pl. 3, f. 4, 5, 1965.

Cells 17.5–18μ long, 13–13.5μ broad, and isthmus 4.3–4.7μ broad. Pl. 1, fig. 21.

Hab. No. 7. Distr. India, Nepal, Ceylon, China, Japan, Manchuria, Burma, Europe, Greenland, Alaska, U. S. A., S. America and Africa.

These are slightly larger cell than the cells of *C. subtumidum*. Semicells with more rounded lateral margin and apical angles are more broadly rounded than those of *C. subtumidum*. Semicells of *C. subtumidum* are truncate-pyramidate or trapeziform and give a impression of rounded outline. The Swedish forms reported by BORGE as *C. subtumidum* seem to me belong to *C. regulare*.

Cosmarium reniforme (RALFS) ARCH. in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 157, pl. 79, f. 1, 2, pl. 82, f. 15, 1908; HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 175, pl. 26, f. 5, 1957.

Cells 48.5–53μ long, 35–39.6μ broad, and isthmus 16.7–19μ broad. Pl. 3, fig. 5.

Hab. Nos. 19, 20. Distr. Japan, Europe, Spitzbergen, Faeroes, Greenland, U. S. A. and S. America.

The ornamentation of granules on the face of the semicell consists of both vertical and oblique series. MESSIKOMMER reported *C. dentiferum* var. *alpinum* similar to this species from Davos. His form is reniform and is slightly larger than those of the present form. The arrangement of granules is rather radial in concentric series.

Cosmarium retusum (PERTY) RABENH. var. **angustatum** W. & G. S. WEST in Monogr. Brit. Desm. **3**, p. 266, pl. 91, f. 3, 1908; HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 197, pl. 28, f. 4, 1957.

Cells 26–27μ long, 22–22.5μ broad, and isthmus 7μ broad. Pl. 3, fig. 15.

Hab. No. 3. Distr. Japan and Europe.

The Himalayan specimens resemble the forms reported from Iceland. The lower lateral margin of the semicell is convex and furnished with 4 or 5 granules; the apex broad and almost truncate-straight; the cell wall is furnished with granules within lateral and apical margin.

Cosmarium subcostatum NORDST. in Öfv. K. Vet. Akad. Förh. p. 37, pl. 12, f. 13, 1876; W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 236, pl. 87, f. 3–5, 1908; HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 196, pl. 28, f. 26, 1957.

Cells 31–32μ long, 26.5–27μ broad, and isthmus 9–10μ broad. Pl. 3, fig. 12.

Hab. No. 25. Distr. Ceylon, Japan, Europe, Greenland, Alaska and Arctic Canada.

The specimensr esemble *C. subcrenatum*. Apex almost straight and scarcely emarginate, while the lateral crenae of *C. subcrenatum* are rounded.

forma **minor** W. & G. S. WEST in Monogr. Brit. Desm. **3**, p. 238, pl. 87, f. 6–9, 1908; FÖRSTER, Ark. Bot. ser. 2, **6**: 3, p. 149, pl. 8, f. 3, 1965.

Cells 21–22μ long, 17.5–18μ broad, and isthmus 6.5μ broad. Pl. 2, fig. 12.

Hab. Nos. 6, 7. Distr. Burma, Europe, Alaska, U. S. A., and Africa.

Cosmarium subcrenatum HANTZSCH in Öfv. K. Vet. Akad. Förh. p. 21, pl. 6, f. 10, 11, 1875; W. & G. S. WEST, Ann. Roy. Bot. Gard. Calcatta **6**, p. 207, pl. 12, f. 18, 1907; Monogr. Brit. Desm. **3**, p. 228, pl. 86, f. 10–14, 1908; HIRANO, Faun. Flor. Nepal Himalaya p. 26, 1955; FÖRSTER, Ergebn. Forsch. -Unters. Nepal Himalaya **2**, p. 48, pl. 4, f. 4, 1965.

Cells 31–33μ long, 24–27μ broad, and isthmus 8.7–9μ broad. Pl. 3, fig. 13.

Hab. Nos. 20, 22. Distr. Nepal, Burma, S. China, Sumatra, Japan, Manchuria, Siberia, Europe, Greenland, Spitzbergen, N. & S. America and Africa.

The specimens resemble *C. subspeciosum* but is smaller. The side convex and 6-crenulated upper crenations are larger than the lower one; apex is 4 crenated, but sometimes seems to be almost straight.

Cosmarium subspeciosum NORDST. in Öfv. K. Vet. Akad. Förh. p. 22, pl. 6, f. 13, 1875; W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 252, pl. 89, f. 11, 1908; GRÖNBLAD, Act. Soc. Faun. Flor. Fenn. **47**, p. 49, pl. 6, f. 49. 50, 1920.

Cells 41.5–44μ long, 31–36μ broad, and isthmus 13–15μ broad. Pl. 3, fig. 2, 4.

Hab. No. 15. Distr. Ceylon, Siberia, Japan, Europe, Spitzbergen, Greenland, Novaya Zemlya, N. America, Brazil and Africa.

The Himalayan forms coincided with the English form described by WEST. Semicells are pyramidate-subsemicircular, margins crenate, apical crenation four, lateral crenation 5–7. Of these, the upper three crenations, including the apical angle, are larger than the others. The lowermost crenation is in some specimens further divided into two small crenations and then the number of lateral crenation appears like 6 or 7. The series of inframarginal granules consist of 4–5; the three outer series are binate, and the inner ones become single granules: semicells with a granulated tumour in the centre above the isthmus.

Cosmarium subtumidum NORDST. in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 192, pl. 63, f. 18–20, 1905; SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**: 5, p. 143, pl. 30, f. 16, 1949.

Hab. No. 23. Distr. Cosmopolitan.

Cosmarium tinctum RALFS in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 168, pl.

61, f. 16–18, 1905; INSAM & KRIEGER, Hedw. **76**, p. 110, pl. 1, f. 11, 12, 1936.

Cells 12–12.5μ long, 11–11.5μ broad, and isthmus 4.5–5μ broad. Pl. 3, fig. 7.

Hab. No. 20. Distr. Japan, China, Manchuria, Burma, Europe, and N. America.

The colour of the cell wall in the British forms of this species is said to be reddish-brown, from the description of WEST, but the Himalayan forms of the present collections coincide with the British forms in shape and in size, except for the colour of the cell wall. According to the explanation of WEST, the cells bearing a colourless cell wall are known from Norway and Greenland. The present specimens resemble *C. tenue* but the sinus of cell is not so deep as those of that species; the constriction of the cell is far deeper than in *C. tenue*. The specimens are similar to *C. inconspicuum*, but the sinus of this species is acute, while those of *C. inconspicuum* are rounded at the extremity, and the sinus also deeper than that of the *C. tinctum*. The present species should be compared with *C. subarctoum*. The different points to be distinguished from that species are the following: the shape of the semicell is not depressed elliptically; the apex of the semicell is convex, and smaller in the size of the cells.

Cosmarium undulatum CORDA var. **crenulatum** (NÄG.) WITTR. in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 150, pl. 59, f. 11, 12, 1905; HIRANO, Contr. Biol. Lab. Kyoto Univ. **4**, p. 116, pl. 19, f. 14, 15, 1957.

Cells 23–24μ long, 17–17.6μ broad, and isthmus 4.5–5μ broad. Pl. 3, fig. 3.

Hab. No. 20. Distr. Japan, Europe, Spitzbergen, India, and Brazil.

var. **wollei** WEST in Monogr. Brit. Desm. **2**, p. 150, pl. 59, f. 8–10, 1905; INSAM & KRIEGER, Hedw. **76**, p. 110, pl. 3, f. 28, 1936.

Cells 37–38μ long, 27.3–28μ broad, and isthmus 9μ broad. Semicells almost semicircular, margin crenulate. Two apical crenations are somewhat larger than those of the lateral, which are become in indistinct towards down.

Hab. No. 5. Distr. Europe and U. S. A.

Cosmarium westii BERNARD in SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**: 5, p. 145, pl. 26, f. 5–7, 1949.

var. **attenuatum** HIRANO, var. nov.

Cellulae minores quam in forma typica, 50μ long, 31μ lat., et lat. isth. 30μ, levissime constrictae ad medium; semicellulae pyramidato-triangulares, valide attenuatae versus apicem, apice subtruncato et leviter convexo, marginibus lateralibus levissime convexis. Pl. 2, fig. 17.

Hab. No. 3.

This new variety is smaller than the typical form of this species, and the semicells are narrowed rapidly towards the poles; the lateral margin is almost straight.

Cosmarium wittrockii LUND. in Nov. Act. Reg. Soc. Sci. Ups. ser. 3, **8**, p. 31, pl. 3, f.

14, 1871; W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 179, pl. 78, f. 19, 1908; HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 175, pl. 26, f. 14, 1957.

Cells 26.5–27μ long, 19.7–20.4μ broad, and isthmus 11μ broad. Semicells are elliptic, with convex apex. The cell wall is furnished with somewhat larger granules which are disposed about 5 transverse series across the face of the semicell. Pl. 1, fig. 5.

Hab. No. 5. Distr. Thailand, Japan, Siberia, Europe and Novaya Zemlya.

This species is similar to *C. portianum*, but is distinguished from that species by the lack of an elongated isthmus.

Arthrodesmus triangularis LAGERH. var. **latiusculum** (W. & G. S. WEST) HIRANO in Contr. Biol. Lab. Kyoto Univ. **5**, p. 210, pl. 29, f. 24, 1957.

Cells 24–25μ long, 24–25μ broad without spine, and isthmus 7.5μ broad.

Hab. No. 24. Distr. Japan and Europe.

Euastrum bidentatum NÄG. in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 39, pl. 37, f. 16–19, 1905; OKADA, Journ. Imp. Fish. Inst. **30**, p. 152, pl. 22, f. 4, 1934; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 601, pl. 85, f. 1, 2, 1937; FÖRSTER, Ergebn. Forsch. -Unters. Nepal Himal. Lief. 2, p. 128, pl. 2, f. 17–19, 1965. Pl. 2, fig. 7.

Hab. Nos. 20, 23. Distr. Nepal. Pamir, India, China, Manchuria, Siberia, Japan, N. Kuriles, Europe, Greenland, N. and S. America and Africa.

Euastrum binale (TURP.) EHRENB. var. **gutwinskii** SCHMIDLE in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 53, pl. 38, f. 31, 32, 1905 (as forma); KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 551, pl. 75, f. 13–15, 1937; HIRANO, Contr. Biol. Lab. Kyoto Univ. **7**, p. 232, pl. 34, f. 12, 1959.

Cells 22–23μ long, 16.5–17μ broad, and isthmus 4.4–4.6μ broad. Pl. 1, fig. 2.

Hab. No. 20. Distr. Japan, Siberia, Europe, N. America, N. Africa and Madagascar.

Euastrum cuneatum JENNER in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 25, pl. 36, f. 9, 1905; OKADA, Journ. Imp. Fish. Inst. **30**, p. 153, pl. 23, f. 3, 1934; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 479, pl. 56, f. 1–4, 1937; HIRANO, Contr. Biol. Lab. Kyoto Univ. **7**, p. 246, pl. 32, f. 13, 1959.

Cells 80–98μ long, 44–48μ broad, and isthmus 12–14μ broad.

Hab. Nos. 20, 23. Distr. Japan, Kuriles, Europe, Greenland, N. America, Australia and New Zealand.

Euastrum erosum LUND. var. **evolutum** CEDERGREN, in Ark. Bot. **25A**, p. 38, f. 21, 1933; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 578, pl. 78, f. 30, 1937.

Cells 30–31μ long, 20–20.4μ broad and isthmus 6.5μ broad. Pl. 1, fig. 1.

Hab. No. 7. Distr. Europe.

Euastrum oblongum (GREV.) RALFS in Brit. Desm. p. 80, pl. 12, f. a-g, 1848; W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 12, pl. 34, f. 7-9, pl. 35, f. 2, 1905; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 526, pl. 70, f. 3-6, 1937; HIRANO, Contr. Biol. Lab. Kyoto Univ. **7**, p. 255, pl. 31, f. 11, 1959.

Cells 141-158μ long, 70.4-83.6μ broad, and isthmus 24-26μ broad.

Hab. Nos. 20, 23. Distr. Japan, China, Siberia, Europe, Greenland, N. & S. America and Africa.

Staurastrum avicula BRÉB. in GRÖNBLAD, Act. Soc. Faun. Flor. Fenn. **47**, p. 57, pl. 3, f. 36-38, 1920; WEST & CARTER, Monogr. Brit. Desm. **5**, p. 40, pl. 133, f. 8-10, 1923; SMITH, Wisc. Bull. **57**, p. 71, pl. 68, f. 8-10, 1924; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 316, pl. 41, f. 5, 1959.

Cells 25-27μ long, 25.5-28μ broad with spine, and isthmus 9.7-10μ broad. Pl. 2, fig. 8.

var. **subarcuatum** (WOLLE) WEST in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 41, pl. 133, f. 11, 1923; DICK, Krypt. Forsch. **1**, p. 451, pl. 21, f. 22, 1926; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 316, pl. 40, f. 25, 1959.

Cells 32-35μ long, 32-35μ broad, and isthmus 11μ broad.

Hab. No. 20. Distr. India, Japan, Europe, U. S. A., and Australia.

Staurastrum dickiei RALFS var. **circulare** TURNER in K. Sv. Vet. Akad. Handl. **25**, p. 105, pl. 16, f. 5, 1893; WEST & CARTER, Monogr. Brit. Desm. **5**, p. 5, pl. 129, f. 16, 1923; KRIEGER, Arch. Hydrobiol. Suppl. **11**, p. 197, pl. 14, f. 15, 1932; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 304, pl. 39, f. 11, 1959.

Hab. No. 6. Distr. India, Sumatra, Japan, Europe, U. S. A., and Central Africa.

Staurastrum dilatatum EHRENB. in W. & G. S. WEST, Monogr. Brit. Desm. **4**, p. 172, pl. 126, f. 10-15, 1911; HIRANO, Contr. Biol. Lab. Kyoto Univ. **7**, p. 297, pl. 39, f. 1, 1959; FÖRSTER, Ergebn. Forsch.-Unters. Nepal Himal. Lief. 2, p. 51, pl. 5, f. 19, 20, 1965; Ark. Bot. Ser. 2, **6**: 3, p. 154, pl. 8, f. 16, 1965.

Cells 39-40μ long, 40-41μ broad, and isthmus 6-7μ broad. Pl. 1, fig. 3.

Hab. No. 6. Distr. Nepal, India, Ceylon, Japan, Europe, Greenland, N. &. S. America, Australia, New Zealand, Africa and Madagascar.

Staurastrum hirsutum (EHRENB.) BRÉB. in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 65, pl. 138, f. 4-6, 1923; OKADA, Bot. Mag. **50**, p. 433, pl. 7, f. 10, 1936; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 323, pl. 41, f. 11, 12, 1959.

Cells without spine 35-38μ long, 35-37μ broad, and isthmus 11-12μ broad.

Hab. No. 20. Distr. Japan, Manchuria, Europe, Spitzbergen, Greenland, Faeroes, N. & S. America.

Staurastrum punctulatum BRÉB. in W. & G. S. WEST, Monogr. Brit. Desm. **4**, p. 179,

pl. 127, f. 8–11, 13, 14, 1911; HIRANO, Faun. Flor. Nepal Himal. p. 31, 1955; Contr. Biol. Lab. Kyoto Univ. **7**, p. 299, pl. 38, f. 13, 1959; FÖRSTER, Ergebn. Forsch.-Unters. Nepal Himal. Lief. 2, p. 53, pl. 5, f. 5, 1965.

Cells 31–36μ long, 31–33μ broad, and isthmus 9–12μ broad. Pl. 1, fig. 4.

Hab. Nos. 5, 6, 15, 20. 23. Distr. Nepal, India, Burma, Ceylon, Java, Siberia, Japan, Europe, Iceland, Greenland, Spitzbergen, N. & S. America, Australia, New Zealand, and S. Africa.

var. **kjellmani** WILLE in W. & G. S. WEST, Monogr. Brit. Desm. **4**, p. 182, pl. 127, f. 13, 17–19, 21, 22, 1911; HIRANO, Contr. Biol. Lab. Kyoto Univ. **7**, p. 299, pl. 38, f. 15, 1959; FÖRSTER, Ergebn. Forsch. -Unters. Nepal Himal. Lief. 2, p. 53, pl. 5, f. 12–14, 1965; Ark. Bot. Ser. 2, **6**: 3, p. 157, pl. 8, f. 22, 1965.

Cells 35–37.5μ long, 35–36μ broad, and isthmus 13–17μ broad. Pl. 2. fig. 10.

Hab. Nos. 5, 6, 7, Distr. Nepal, Japan, Manchuria, Siberia, Europe, Faeroes, Greenland, Spitzbergen, Novaya Zemlya and Canada.

Staurastrum spongiosum BRÉB. in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 76, pl. 140, f. 14, 1923; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 328, pl. 42, f. 5, 1959.

Cells 48.5–55μ long, 44–48.5μ broad, and isthmus 15.4–17μ broad.

Hab. Nos. 3, 23. Distr. Japan, Siberia, Europe, Spitzbergen, Greenland, N. America and Argentine.

Staurastrum subcruciatum COOKE & WILLS in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 42, pl. 133, f. 6, 7, 1923; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 317, pl. 40, f. 22, 23, 1959.

Cells 27–28μ long, 39–40μ broad, and isthmus 12.4μ broad. Pl. 2, fig. 9.

Hab. No. 20. Distr. Japan and Europe.

Hyalotheca dissiliens (SM.) BRÉB. in WEST, Ann. R. Bot. Gard. Calcatta **6**, p. 225, pl. 12, f. 11–15, 1907; SMITH, Wisc. Bull. **57**, p. 142, pl. 87, f. 8, 9, 1924; WEST & CARTER, Monogr. Brit. Desm. **5**, p. 229, pl. 161, f. 16–27, 1923; HIRANO, Faun. Flor. Nepal Himal. p. 32, 1955; Contr. Biol. Lab. Kyoto Univ. **11**, p. 391, pl. 54, f. 11, 1960; FÖRSTER, Ergebn. Unters.-Nepal Himal. Lief. 2, p. 158, pl. 9, f. 25–27, 1965.

Hab. Nos. 18, 19, 20, 22, 23. Distr. Cosmopolitan.

Photo. 1. General view of the Rangtang Himal (from Ganja La ca. 4500m). The left peak is Sanbonyari and its right is the ice fall of Tshenyi glacier. The left is the Lirung glacier and the base camp was settled at the lower edge of the glacier. Photo. by S. Hojo.

Photo. 2. Alpine lake in the Rangtang Valley (first lake of collection nos. 18–20). The mountain behind the lake is the main peak of Rangtang Lirung. Photo. by S. Hojo.

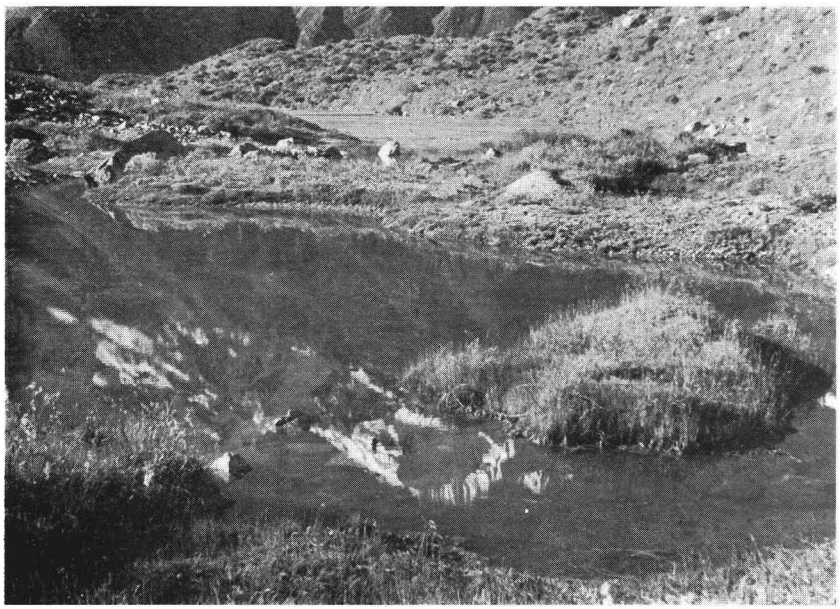


Photo. 3. Shallow pool on the Lirung glacier. The shadow of the white mountain is the Naya Kanga peak. Photo. by S. Hojo.

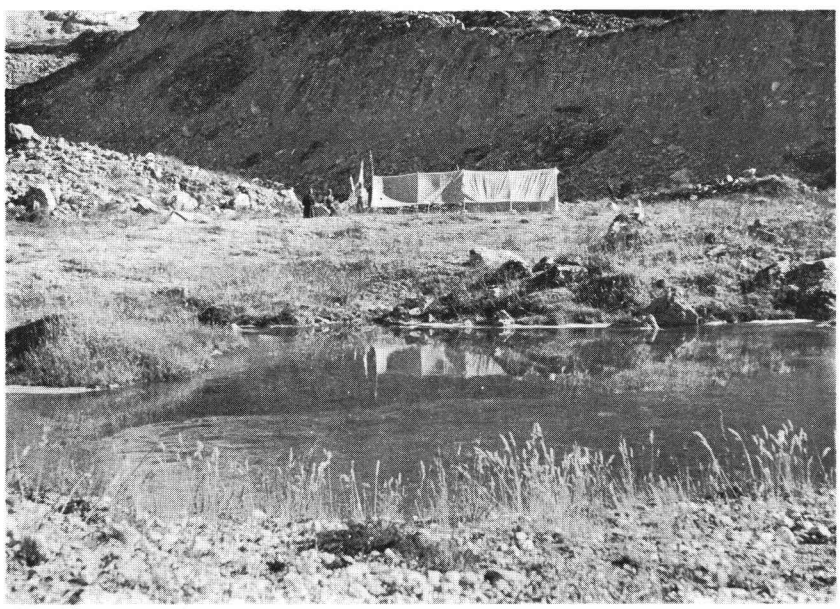


Photo. 4. Same pool near base camp. Photo. by S. Hojo.

Plate 1

1. Euastrum erosum LUND. var. evolutum CEDERGREN
2. E. binale (TURP.) EHRENB. var. gutwinskii SCHMIDLE
3. Staurastrum dilatatum EHRENB.
4. St. punctulatum BRÉB.
5. Cosmarium wittrockii LUND.

6, 7. Anabaena papillosa HIRANO, sp. nov.

8. Characium gracilipes LAMBERT
9. Oedogonium sociale WITTROCK
10. O. rufescens WITTR. var. exiguum (ELFV.) TIFFANY
11. O. suecicum WITTR.
12. O. acrosporum De BARY
13. O. curvum PRINGSHEIM
14. Oscillatoria pseudominima SKUJA
15. Lyngbya epiphytica HIERON.
16. Scytonema mirabile (DILLW.) BORN.
17. Oscillatoria tenuis AG. var. nigra SCHKORB.
18. O. splendida GREV.
19. O. brevis KÜTZ.
20. Phormidium valderiae (DELP.) SCHMIDLE
21. Cosmarium regulare WILLE
22. Schizochlamys delicatula WEST
23. Oocystis solitaria WITTR.
24. Chaetospheridium globosum (NORDST.) KLEBAHN

1—24 : ×600

Plate 1

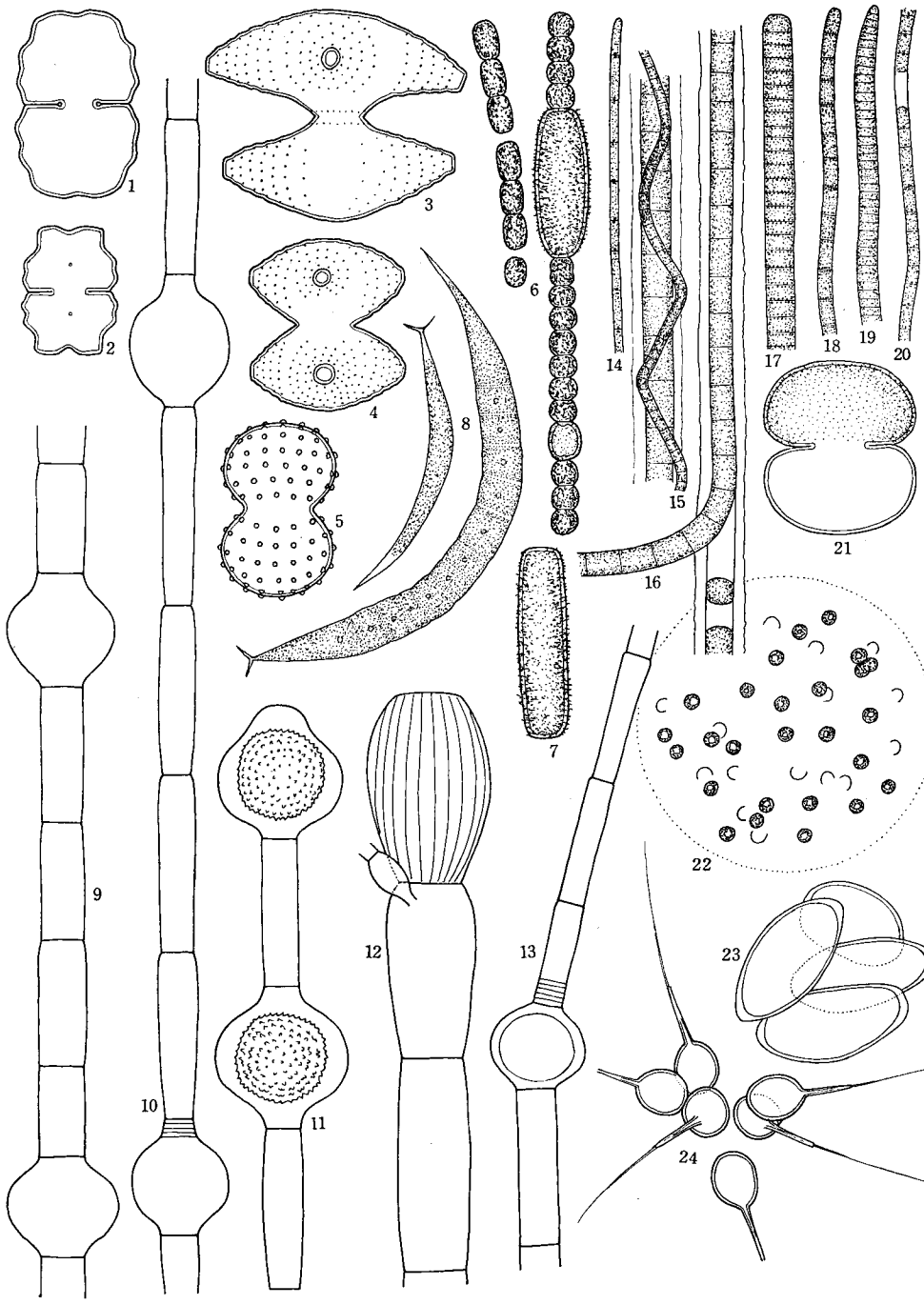


plate 2

1. Cosmarium pseudoprotuberans KIRCHN. var. angustius NORDST.
2. C. pachydermum LUND. var. minus NORDST.
3. C. diplosporum (LUND.) LÜTKEM. forma minor HIRANO
4. C. impressulum ELFV.
5. C. impressulum var. johorense BERNARD
6. C. pericymatium NORDST. var. notabiliforme INSAM & KRIEGER
7. E. bidentatum NÄG.
8. Staurastrum avicula BRÉB.
9. St. subcruciatum COOKE & WILLS
10. St. punctulatum BRÉB. var. kjellmani WILLE
11. Cosmarium connatum BRÉB.
12. C. subcostatum NORDST. forma minor W. & G. S. WEST
13. C. meneghinii BRÉB. forma himalaica HIRANO, f. nov.
14. C. garrolense ROY & BISSET
15. C. polonicum RACIB.
16. C. abscissum GRÖNBL. var. subetchachanense GRÖNBLAD
17. C. westii BERNARD var. attenuatum HIRANO, var. nov.

1—17 : ×900

Plate 2

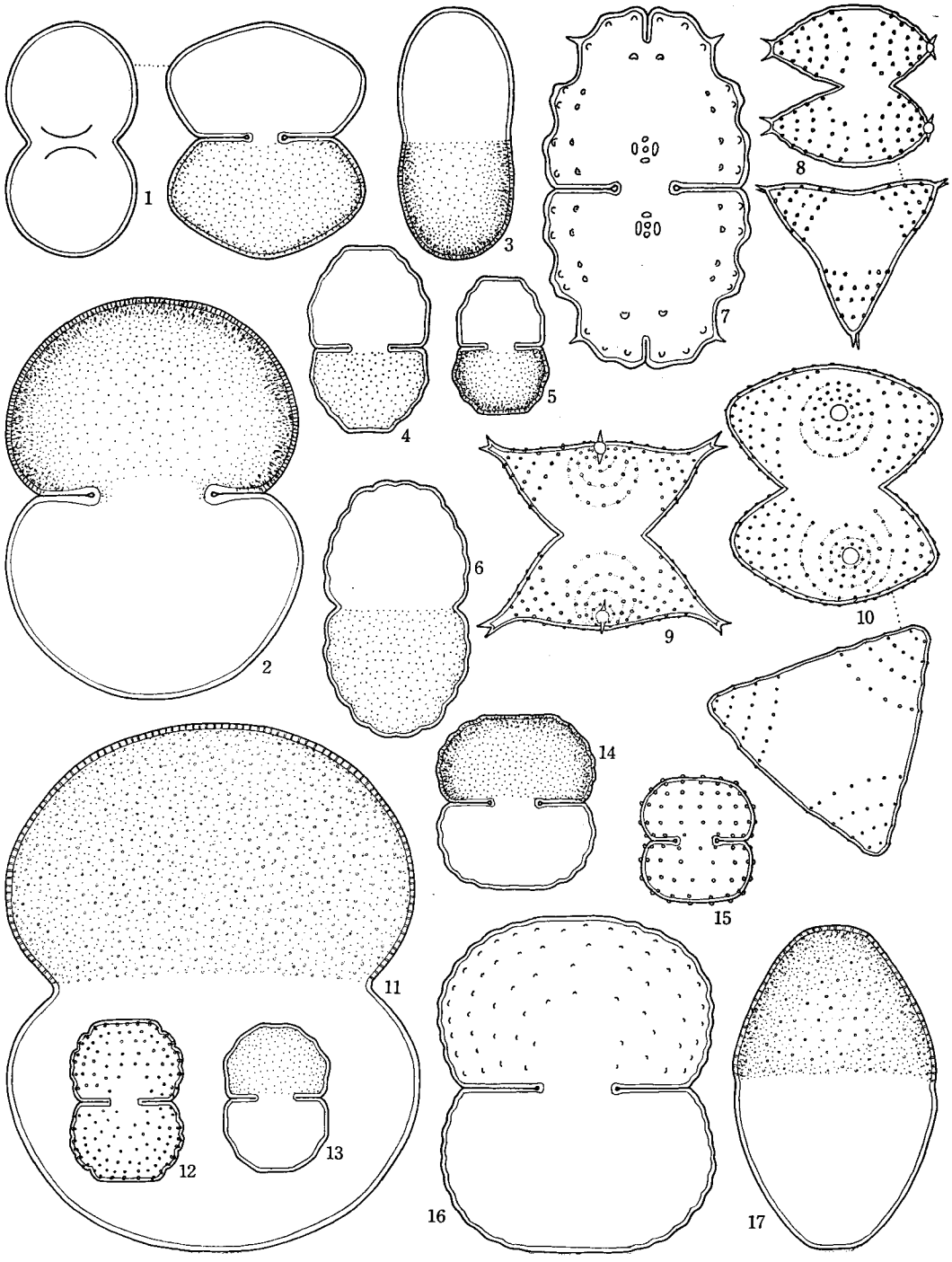


Plate 3

1. Cosmarium praemorsum BRÉB.
2. C. subspeciosum NORDST.
3. C. undulatum CORDA var. wollei WEST
4. C. subspeciosum NORDST.
5. C. reniforme (RALFS) ARCH.
6. C. octagonum TURNER
7. C. tinctum RALFS
8. C. logiense BISSET
9. C. minimum W. & G. S. WEST var. rotundatum MESSIKOMMER
10. C. formosulum HOFF.
11. C. gostyniense (RACIB.) GRÖNBL.
12. C. subcostatum NORDST.
13. C. subcrenatum HANTZSCH
14. C. formosulum HOFF.
15. C. retusum (PERTY) RABENH. var. angustatum W. & G. S. WEST
16. C. botrytis MENEGH. var. rangtangense HIRANO, sp. nov.

1—16 : ×850

Plate 3

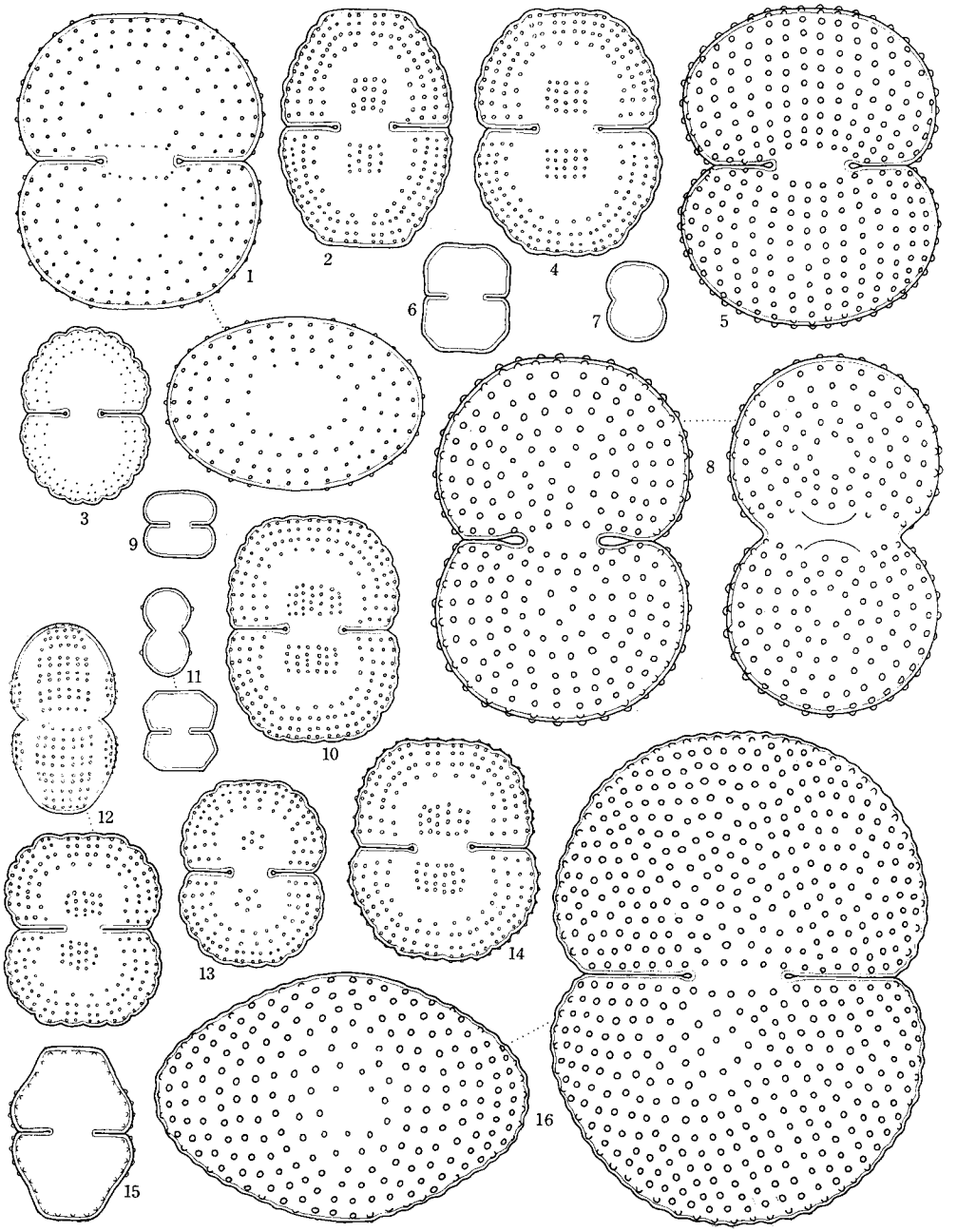


Plate 4

1. Eunotia valida HUSTEDT
2, 3. E. praerupta EHRENB. var. bidens GRUN.
4. E. pectinalis (DILLW.) RABENH. var. undulata RALFS
5. E. nepalense HIRANO, sp. nov.
6. Ceratoneis arcus (EHRENB.) KÜTZ. var. recta (CLEVE) KRASSKE
7. Diatoma vulgaris BORY var. linearis GRUN.
8. Hantzschia amphioxys (EHRENB.) GRUN. var. amphilepta GRUN.
9. Nitzschia goetzeana O. MÜLL. var. gracilior HUSTEDT
10. Cymbella gracilis (RABENH.) CLEVE
11. Hantzschia amphioxys (EHRENB.) GRUN. var. pusilla DIPPEL
12. Nitzschia hantzschiana RABENH.
13. Diatoma elongatum (LYNGB.) AG. var. tenuis (AG.) V. H.
14. Amphora coffaeiformis AG. var. borealis (KÜTZ.) CLEVE
15, 16. Diatoma hiemale (LYNGB.) HEIB. var. mesodon (EHRENB.) GRUN.
17, 18. Eunotia pectinalis (DILLW.) RABENH. forma minor (KÜTZ.) RABENH.
19, 20. Eunotia arcus EHRENB.
21. Ceratoneis arcus (EHRENB.) KÜTZ. var. recta (CLEVE) KRASSKE
22. Gomphonema abbreviatum AG. ? KÜTZ.
23. Diatoma hiemale (LYNGB.) HEIB.
24. Cyclotella comta (EHRENB.) KÜTZ.
25. Cymbella cistula (HEMPR.) GRUN.
26. C. cymbiformis KÜTZ. var. multipunctata A. CLEVE
27. C. aequalis W. SM. var. subaequalis GRUN.
28. C. amphicephala NÄG.
29. C. naviculiformis AUERSW.
30. Achnanthes kryophila BOYE-PETERSEN
31. Eunotia tschirchiana O. MÜLL.
32, 33. Eunotia papillio (GRUN.) HUSTEDT
34–36. Gomphonema gracile EHRENB.
37. Fragilaria capucina DESM. var. lanceolata GRUN.
38. Gomphonema lanceolatum EHRENB.

1—38 : ×1000

Plate 4

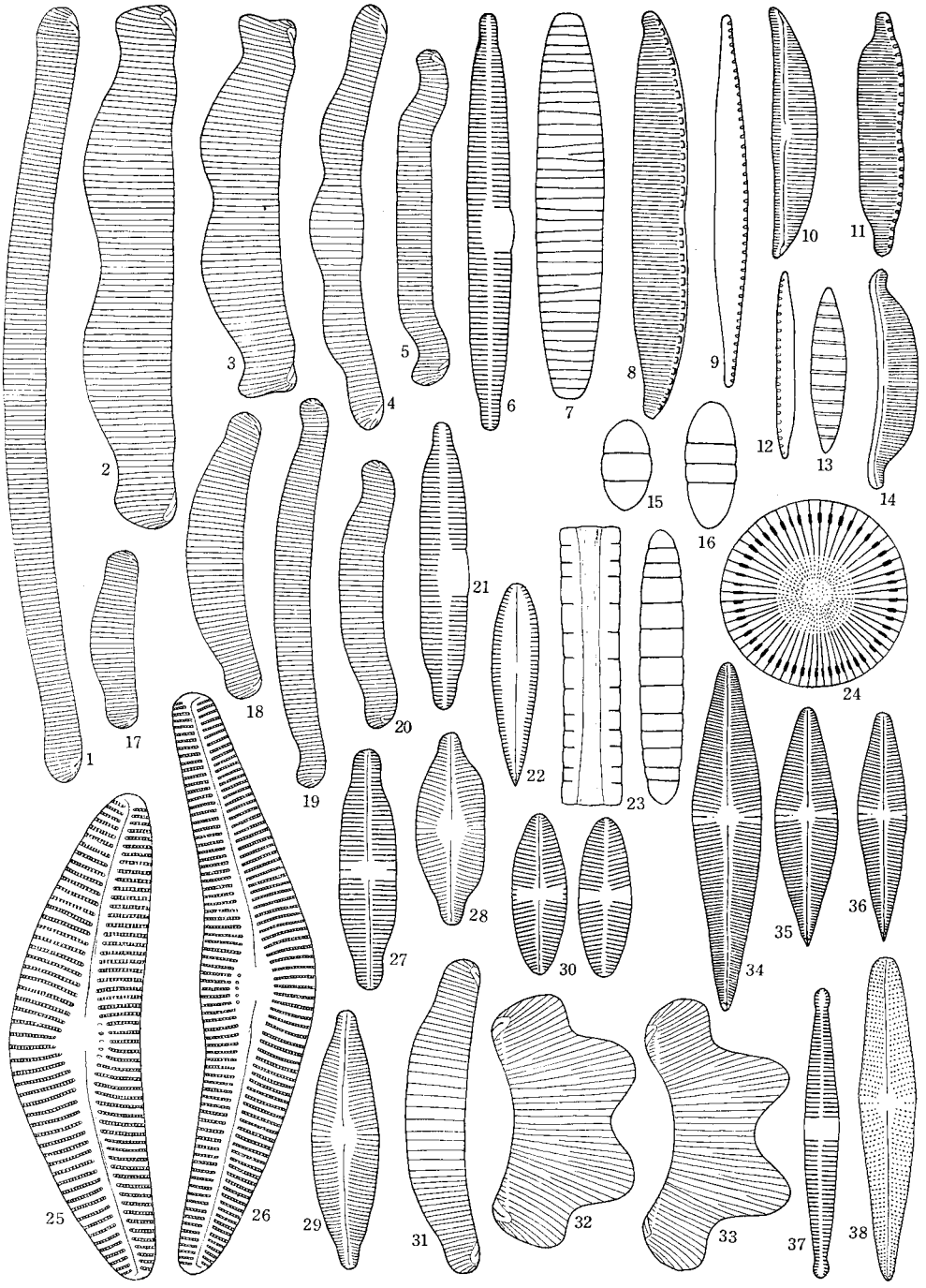

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Plate 5

1. Synedra ulna (NITZSCH) EHRENB.
2. S. ulna var. ramesi (HEIB. & PERAG.) HUSTEDT
3. Pinnularia crucifera A. CLEVE var. elongata A. CLEVE
4. P. major (KÜTZ.) CLEVE var. linearis CLEVE
5. Stauroneis phoenicenteron EHRENB. var. lanceolata (KÜTZ.) DIPPEL
6. P. macilenta (EHRENB.) CLEVE
7. P. hustedtii MEISTER var. rangtangense HIRANO, var. nov.
8. Achnanthes exigua GRUN. var. constricta TORKA
9. Cocconeis placentula (EHRENB.) HUSTEDT var. lineata (EHRENB.) CL.
10. Anomoeoneis serians (BRÉB.) CLEVE var. brachysira (BRÉB.) CL.

11, 12. Pinnularia subcapitata GREGORY var. lapponica A. CLEVE

13. Navicula pupula KÜTZ. var. bacillarioides GRUN.
14. Anomoeoneis serians (BRÉB.) CLEVE var. brachysira (BRÉB.) CLEVE foma thermalis (GRUN.) HUSTEDT

15, 16. Anomoeoneis exilis (KÜTZ.) CLEVE var. lanceolata A. MAYER

17. Pinnularia biceps GREGORY
18. P. borealis EHRENB.
19. P. viridis (NITZSCH) EHRENB. var. fallax CLEVE
20. P. stauroptera (RABENH.) CLEVE var. subparallela MAYER
21. Navicula siofokensis PANT.
22. Cymbella ventricosa KÜTZ.

1—3, 6, 8—22 : ×1000 ; 4 : ×500 ; 7 : ×800

Plate 5